VOLUME LIV OCTOBER, 1944 NUMBER 10

THE LARYNGOSCOPE

FOUNDED IN 1896
BY
MAX A. GOLDSTEIN, M. D.

PUBLISHED BY
THE LARYNGOSCOPE
640 SOUTH KINGSHIGHWAY ST. LOUIS (10), MO., U. S. A.

NOTICE TO CONTRIBUTORS

THE LARYNGOSCOPE reserves the right of exclusive publication of all articles submitted. This does not preclude their publication in Transactions of the various Societies.

Manuscripts should be typewritten, double spaced, on one side of paper only and with sufficient margins to allow for corrections.

References should be complete: authors surname, initials, title of article, journal, volume, page, month, year.

Six illustrations will be furnished for each article without cost to author. Authors will please limit illustrations to six or assume the expense of additional illustrations.

Proofs will be submitted to authors for corrections. If these are not returned, articles will be published as corrected in this office:

Reprints will be furnished at the following prices:

WITHOUT COVER

	250 Copies	500 Copies	1000 Copies	2000 Copies
Four Pages	$ 5.75	$ 7.00	$ 9.50	$14.50
Eight Pages	12.00	14.50	19.50	29.50
Twelve Pages	17.00	21.25	30.00	47.50
Sixteen Pages	21.50	26.50	36.50	56.50
Twenty Pages	26.25	32.75	46.00	72.50
Twenty-four Pages	30.50	38.00	53.00	82.00
Thirty-two Pages	40.50	48.25	65.00	98.50

WITH COVER

	250 Copies	500 Copies	1000 Copies	2000 Copies
Four Pages	$ 9.75	$12.50	$18.00	$29.00
Eight Pages	16.00	20.00	28.00	44.00
Twelve Pages	21.00	26.75	38.50	62.00
Sixteen Pages	25.50	32.00	45.00	71.00
Twenty Pages	30.25	38.25	54.50	87.00
Twenty-four Pages	34.50	43.50	61.50	97.50
Thirty-two Pages	44.50	53.75	73.50	113.00

Express charges to be paid by consignee.

THE

LARYNGOSCOPE.

VOL. LIV — OCTOBER, 1944. — No. 10

REHABILITATION OF THE CHILD WHO IS HANDICAPPED BY DEAFNESS.*†

RUTH P. GUILDER, M.D., and LEROY A. SCHALL, M.D.,
Boston.

Children with irreversible hearing handicaps call for expanded clinic programs as never before. They are the last group of physically handicapped children to receive complete clinical recognition, medical study and guidance throughout the rehabilitation period. Heretofore, their habilitation or rehabilitation has necessarily been largely educational — teaching them to supplement or substitute visual patterns for auditory patterns in the understanding of speech. With the possibility of improved hearing for the majority of partially deaf and hard-of-hearing boys and girls through the new vacuum tube hearing aid, children with irreversible hearing handicaps present to the otological clinic an entirely new set of responsibilities and opportunities for service. For a considerable group of these children, better hearing is no longer a dream, but a reality, and through better hearing, better speech, better language and the possibility of proceeding or remaining with their normal group. Few fields in the rehabilitation of handicapped children are more challenging or more full of hope at the present moment.

AN EXPERIMENT IN REHABILITATION.

Early in the development of a clinical research program

*Read at the Seventy-seventh Annual Meeting of the American Otological Society, Inc., New York, June 6, 1944.

†From the Winthrop Foundation for the Study of Deafness at the Massachusetts Eye and Ear Infirmary.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, June 30, 1944.

for deafness in children, it became apparent that there was need for not only intensive initial study, examination and treatment, adapted to the different age levels and the needs of the individual child, but also for the development of an equally intensive and individualized program for the habilitation, rehabilitation and continued guidance of the child with an irreversible hearing handicap.

It was also apparent from the beginning that many problems relating to the clinical habilitation and rehabilitation of children with hearing handicaps called for clinical investigation. Chief among these were: *1.* Development of a further intensive study program so that the child could be helped to reach his highest level of health and efficiency; *2.* establishment of criteria for the recommendation of hearing aids and other remedial measures at the different age levels and in the different types of deafness; *3.* development of individual and group clinic teaching programs to assist in the initial adjustment at the different age levels (comparable to clinical developments in many other fields) ; *4.* revision of criteria for educational recommendations based on the child's maximum potential hearing after clinical habilitation and rehabilitation.

An attempt has been made during the past three years at the Massachusetts Eye and Ear Infirmary to explore some of the problems and to establish, on an experimental basis, a program of rehabilitation to supplement the clinical research program. An effort has been made at every point to integrate the two programs so closely that remedial measures become another form of therapy, which in reality they are. The study program, as originally planned, calls for: *1.* Continued otological and pediatric consultation and recommendations, and other special medical consultations, as indicated; *2.* medical social study as to school, home and community adjustment or lack of adjustment; *3.* psychological study, including psychometric and school achievement tests at intervals; and *4.* educational evaluation of special disabilities. Ideally, the staff should include, in addition to otological, medical and research personnel, a medical social worker, a secretary, a psychologist and a qualified teacher of the deaf. Our experimental effort has included these services most of

the time, although we have not yet been able to add a *full-time* teacher to the staff.

Each child, particularly in the group under 12, has been found to present his own individual problems, and has been studied from the standpoint of listening habits with and without an aid, ability to use lip-reading as an aid to hearing, speech defects or auditory origin, school achievement and general mental development. On the basis of all these studies, an individualized remedial program has been outlined for

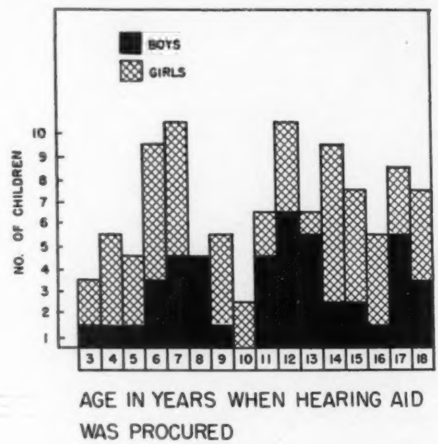


Fig. 1.

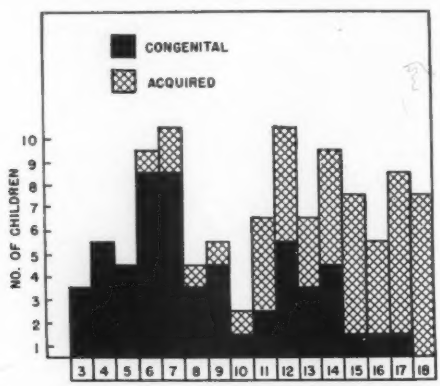
each child, and individual and group clinic training arranged whenever possible. During the clinic remedial program, the child has been given the benefit of medical, social, psychological and educational guidance, and the final educational recommendations have been based on observation of his progress under training. Needless to say, facilities have not made it possible for the complete program in every instance.

HEARING AIDS IN THE PROGRAM.

Under the experimental program, hearing aids have been issued to 100 children. The group is composed of 43 boys and 57 girls, who ranged in age from 3 to 18 years at the

time the hearing aid was procured (see Fig. 1). The reasons for the shape of the curve become clearer as we turn to Fig. 2, which shows the relation of congenital to acquired deafness in the group. While a small but increasing number of partially deaf children are coming for help during preschool years, the peak age for the procuring of aids for children with congenital impairments is still at the 6- to 7-year level, meaning that many go undetected until they reach school age.

Vacuum tube aids approved by the Council of Physical Therapy of the American Medical Association have been used



RELATION OF CONGENITAL TO ACQUIRED DEAFNESS AMONG CHILDREN PROCURING AIDS AT THE DIFFERENT AGE LEVELS.

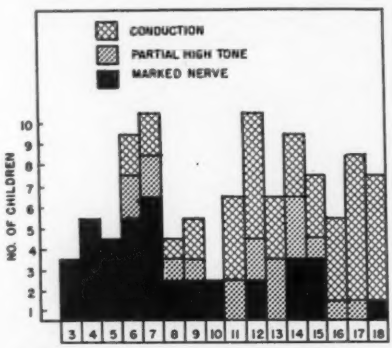
Fig. 2.

throughout the group, with the exception of carbon aids for two individuals, and a small number of custom-built vacuum tube aids of a local make, approved by the infirmary staff. Eight different makes of Council-approved vacuum tube aids are presented in the group in varying proportions.

Hearing aids have been introduced naturally during the expanded hearing study, with some of the same techniques,

adapted to the different age levels — word-picture method and sound-conditioning games at the younger age levels, and different types of school and general material, often on a game basis, for the slightly older boys and girls.

Aids have been compared and recommended, at first on the basis of results with voice and whisper tests with word and sentence lists and different types of school material at 20 feet, and later with phonograph speech records through a loud speaker linked into the audiometer and phonograph circuit.



DISTRIBUTION ACCORDING TO THREE PRINCIPAL TYPES OF DEAFNESS AMONG CHILDREN PROCURING AIDS AT THE DIFFERENT AGE LEVELS.

Fig. 3.

While it has been found that approved aids differ somewhat in their effectiveness in different types of deafness, and that an effort must always be made to secure the best result, the present report is an analysis of the application of aids at the younger age levels, and not an analysis of the effectiveness of individual makes of aids. An attempt has been made always to give each child the best possible hearing.

Under this program, hearing aids have been recommended for three principal types of deafness: *1.* Conduction deafness; *2.* partial high tone deafness; and *3.* more marked

nerve deafness (see Fig. 3). The distribution among the three types is as follows:

Conduction deafness	43
Partial high tone deafness	19
More marked nerve deafness	38
Total	100

Since the criteria for recommendation, the results to be expected, the difficulty of adjustment and the amount of special training needed, vary according to the type of deafness,

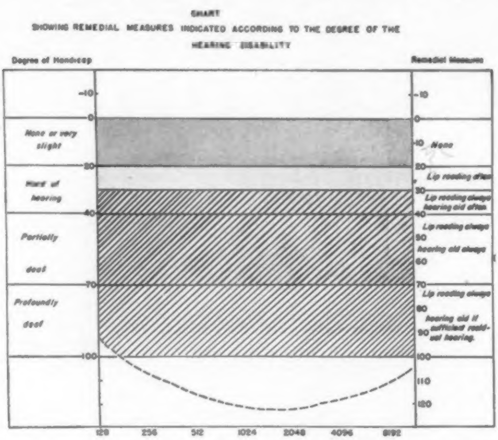


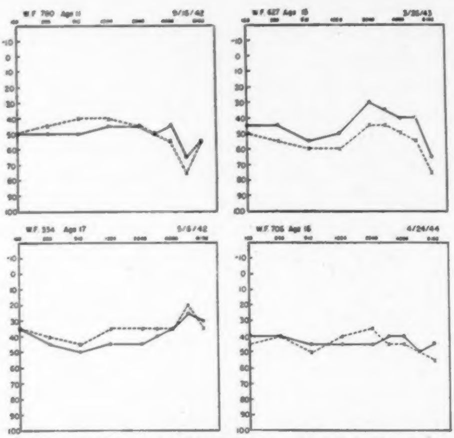
Fig. 4.

we will consider briefly the problems and results in each group, with a special section for the problems of the preschool child.

In Conduction Deafness: Hearing aids have been placed on 43 children with conduction deafness, ranging in age from 6 to 18 years, the larger number being in the 12- to 18-year level (see Fig. 3). Aids were recommended for this group when the loss in the better ear approached 30 db. (see Fig. 4), bearing in mind always that slighter losses are far more handicapping in childhood than in adult years, and that we are justified in recommending an aid whenever hearing distance for new material is reduced or whenever a remedi-

able hearing disability is interfering with good speech development.

Air conduction vacuum tube aids have been found to give better hearing than bone conduction aids even in conduction deafness and have been recommended throughout this group except in six instances, when bone conduction was required for specific reasons: once because of bilateral congenital malformation of the external and middle ear, four times because



TYPICAL AUDIOGRAMS FOR CONDUCTION DEAFNESS IN WHICH HEARING AIDS HAVE BEEN RECOMMENDED RIGHT EAR •———•, LEFT EAR x-----------x

Fig. 5.

of intermittent otitis media, and twice on the poorer ear in young children when the loss in the better ear was still slight but beginning to be a handicap.

The audiograms in Fig. 5 are typical of the conduction impairments for which aids have been recommended. In every instance the aid has given a hearing distance of 20+ feet for conversation and whisper. In most instances it has brought the pure tone level to between 0 and 20 db. over the speech range, and the level for words (phonograph record through loud speaker) to within a range of 10 db. of the established normal threshold. Gain with aids for the four

children whose audiograms appear in Fig. 5 are shown in the following table:

			Gain in Decibels for Pure Tones					Distance for Conversation	
No.	Age	Sex	256	512	1,024	2,048	For Words	Without Aid	With Aid
780	11	M	30	40	30	35	25	2 ft.	20+ ft.
627	15	M	25	30	25	20	25	2 ft.	20+ ft.
334	17	F	20	35	30	20	25	5 ft.	20+ ft.
706	16	F	25	30	40	35	20	2 ft.	20+ ft.

Gain with aid in conduction deafness.

With the exception of three instances in which the conduction impairment was of congenital origin, this group entered school with normal hearing and normal speech; the interval between the onset of their progressive hearing loss and the procuring of an aid varied from 18 months to 13 years. During that interval they had become increasingly discouraged. They were constantly losing their places when children behind them recited, they failed in their spelling lessons if the teacher moved where they could not read her lips. One little 10-year-old girl had been unhappy because the teacher asked her to stand when she did not hear, and the result was that she had been standing most of the time the past year.

The acceptance of the aid is not easy for the majority in the adolescent and postadolescent group, and only through our longer contact with them in clinic training groups have we been able to rehabilitate as many as we have. Two years ago, aids on young people were not common. It was only by bringing together the boys and girls of high school age and letting them help each other, as well as to benefit their training by combining better hearing with lip-reading, that they were willing to accept the hearing aid. Even then, one 15-year-old boy returned his aid because in a large high school he was the only boy wearing one; a 15-year-old girl returned hers because she was soon leaving school, and did not want to wear it socially. Medical social service is making an important contribution in this program by contacting the home, school and teacher whenever possible; and teachers are most cooperative in paving the way for a child to proceed happily with his newly acquired aid.

No child in this group has at any time been in a school for the deaf, and none had to transfer because of deafness. Ten had repeated one or more grades, largely because of poor hearing, and according to school reports, their work has greatly improved since the aid was procured. In a number of instances the aid made it possible for the child to complete high school. Twenty-three are now wearing their aids constantly at school and for social activities, with occasional lapses; 11 for work and social activities after leaving school; three are in defense jobs where they are unable to wear their aids; one is in the army; one showed sufficient improvement in hearing to give up his aid temporarily at least; two returned their aids (see above); and two have acquired their aids too recently to be evaluated from this angle.

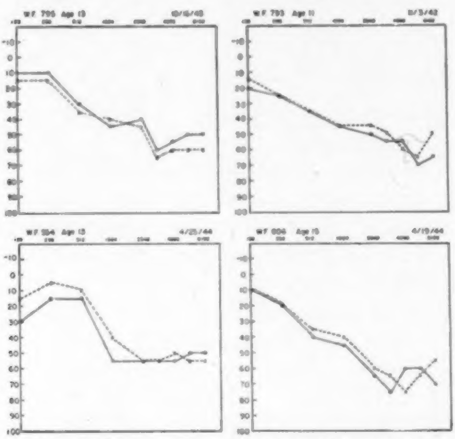
The earliest possible rehabilitation is our goal with this group of boys and girls, and the best results are obtained when the child comes to the clinic for examination and treatment in the incipient stage of his deafness, and is asked to return at regular intervals for continuous study and further treatment or rehabilitation, as these measures become necessary. The way can thus be gradually paved for acceptance of the aid, and the hearing aid becomes simply one step in our study-treatment-follow-up program, which is aimed to give boys and girls better hearing, therapeutically or remedially.

In Partial High Tone Deafness: Hearing aids have been placed on 19 children with partial high tone deafness, ranging in age from 6 to 17 years; the larger number being in the 11- to 14-year level, but a small number being in the 6- to 9-year level (see Fig. 3). Since this defect was probably congenital or developmental in origin in 17 of the 19 children, it is important that the disability be discovered at a younger age, so that the child may be brought for study and habilitation during pre-school years.

The audiograms in Fig. 6 are typical of this particular type of high tone deafness. Because these children hear speech in a distorted manner, speech-development is somewhat retarded and imperfect, and often some of the higher pitched consonant sounds remain imperfect throughout life.

By school age, the majority proceed as essentially normal children, except for their minor speech defects and their reduced hearing distance.

Aids have been recommended in this group when hearing distance for new material is reduced to 12 feet or less, and in young children whenever it is clear that speech development is retarded and imperfect because of a hearing disability of this nature. The advisability of correcting such a congenital defect after the age of 12 years is questionable, and



TYPICAL AUDIOGRAMS FOR PARTIAL HIGH TONE DEAFNESS IN WHICH HEARING AIDS HAVE BEEN RECOMMENDED. RIGHT EAR o———o, LEFT EAR x- - - - -x

Fig. 6.

after the age of 15 years it should be done only under special conditions. Many of these individuals have depended largely on lip-reading for the understanding of speech, and the auditory patterns which they have are based on the imperfectly heard word. After 12 years, it is difficult for them to shift the emphasis from the eye to the ear, and reconstruct their auditory images. One 14-year-old girl, with such a defect from birth, was anxious to acquire an aid, but after a few months returned it because she preferred to continue with lip-reading alone. At the younger age levels the aid is of inestimable value. The two 6-year-olds are continuing in pub-

lic school largely because of the initial help which the hearing aid gave them in speech and language.

A well adjusted hearing aid will usually give these children 20+ feet hearing distance for speech, and make it possible for them to correct their imperfect speech through hearing, with a little expert help. The gain in decibels for pure tones and words, as measured through the loud speaker, for the children whose audiograms appear in Fig. 7, is given in the following table:

			Gain in Decibels for Pure Tones					Distance for Conversation	
No.	Age	Sex	256	512	1,024	2,048	For Words	Without Aid	With Aid
795	13	M	—	20	25	25	20	8-10 ft.	20+ ft.
793	11	M	—	10	25	25	20	6- 8 ft.	20+ ft.
554	13	F	—	—	30	40	20	2-15 ft.	20+ ft.
806	15	F	—	20	25	40	15	0- 6 ft.	20 ft.

Gain with aid in partial high tone deafness.

At the time of procuring the aid, 15 children were in regular classes in public school; four were in schools for the deaf. Since the aid has been procured, two have transferred from a school for the deaf to public school and are progressing well; and one, in spite of his aid, has transferred to a school for the deaf.

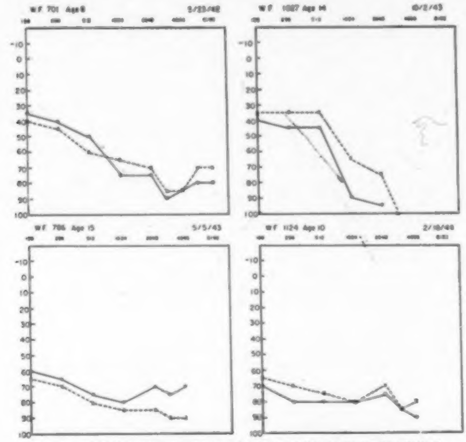
As to present status from the standpoint of the use of the aid, 13 are being worn constantly for school and social activities, with occasional lapses; one older girl has a defense job and has temporarily given up wearing her aid, although it had been only because of the help from her aid that she continued in school the last two years; two have moved and been lost track of; two 13-year-old boys are reluctant to wear their aids to school, but promise each time we contact them that they will do better; and one 14-year-old girl returned hers (see above).

On the whole, the individuals who are wearing them constantly have gained a great deal in clearer speech, increased hearing distance and poise, as well as better grades in school.

In More Marked Nerve Deafness: Hearing aids have been placed on 38 children with marked nerve deafness, ranging in age from 3 to 18 years (see Fig. 3). Eighty per cent of

these children were 12 years of age or under at the time the aid was procured, and 50 per cent were under 7 years of age. This is encouraging when we realize that deafness was congenital in origin in 80 per cent of the group. Of these 38 children, 14 were of preschool age at the time of acquiring the aid, and will be considered in the next section on hearing aids in the preschool child.

In this group are included various types of descending curves, but all with losses greater than 20 db. throughout the lower tone range, in contradistinction to the preceding



TYPICAL AUDIOGRAMS FOR MORE MARKED NERVE DEAFNESS IN WHICH HEARING AIDS HAVE BEEN RECOMMENDED. RIGHT EAR o———o, LEFT EAR x-------x

Fig. 7.

partial high tone group (see Fig. 7). These children possess varying amounts of residual hearing but considerably less than the two preceding groups. We have proceeded with each one cautiously, recommending an aid only when the child already had some hearing vocabulary, or proved under clinic training that he was able to acquire one, and only when we felt that the child, the parents and the teacher would work to make the experiment worthwhile.

Of the children with acquired nerve deafness, one of the most striking results was in a girl of 10 years with a marked

deafness of two years' duration which had reduced the hearing distance in one ear to 12 inches and in the other to two inches. An aid on her better ear gave her a hearing distance of 15 to 20 feet for familiar material, and she was a very happy child when she found that she could again be in touch with the world of sound about her and remain in public school.

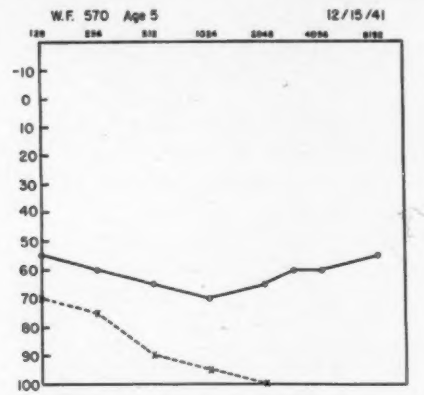
The gain for pure tones and words is naturally not so great in this group because of the marked degree of nerve deafness. The gain in decibels for pure tones and words is not being tabulated for this group until they have had a longer period in which to learn to use their improved hearing to a maximum, and until they have had longer opportunity to increase their hearing vocabularies. The hearing aid plus lip-reading is making it possible for many of these boys and girls to remain in public school and do better work than would otherwise be possible; to have better speech and language; and to be in touch with the world of sound about them. Even a small amount of better hearing means a great deal to the children in this group.

At the time the aids were procured, 14 children were attending regular classes in public school, eight were attending schools for the deaf, and two were attending a school for the blind. After obtaining hearing aids, two transferred from a school for the deaf to public school, and one transferred to a school for the deaf. Part of our study during the rehabilitation period includes an evaluation of present educational placement, and if we feel that even with the aid the child is likely to have difficulty, we sometimes recommend transfer to a school for the deaf or repetition of his present grade in public school, especially if school achievement tests show that he has not absorbed the work of his present grade.

From the standpoint of present use of aids in the 24 individuals of school age, 17 are using them most of the day; three are using group hearing aids during school hours; one girl of 15 years has largely given up wearing her aid; and three have acquired hearing aids too recently to be rated in this respect.

HEARING AIDS FOR PRESCHOOL CHILDREN.

The same science which has made it possible for a voice to be heard around the world in the fraction of a second has made it possible for sounds to reach the brain centers of young partially deaf children and be interpreted as speech. Auditory pathways and centers and auditory patterns for the understanding of speech may now be used from the begin-



AUDIOGRAM OF A CHILD WHO MADE AN EXCELLENT ADJUSTMENT TO HEARING AID IN BETTER EAR AT THE AGE OF FIVE YEARS, AND WHO IS NOW SATISFACTORILY COMPLETING SECOND GRADE IN PUBLIC SCHOOL. RIGHT EAR o——————o LEFT EAR x--------x

Fig. 8.

ning in the speech-language development of many young partially deaf children, who formerly have been taught to depend solely on the substitution of visual patterns. Young children want to hear: much of their early mental growth comes primarily through hearing; therefore, the earlier the hearing handicaps of preschool years can be discovered, evaluated and corrected, the greater the opportunity for a normal childhood and a satisfactory school career.

In the beginning of our experimental program for the habilitation of the preschool child, 5 years seemed the young-

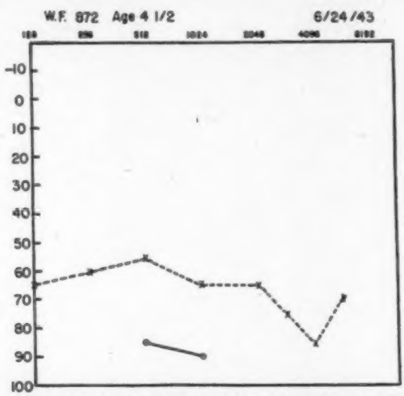
est possible age for the recommendation of a hearing aid; then it was 4 years; and now the youngest age is 3 years. In this way the child has the opportunity of forming auditory images for words from the beginning, instead of artificially later as a supplement for the less natural visual patterns. Let him acquire a knowledge of lip-reading, but if he has useful hearing with the help of an aid, let auditory function take over to the greatest possible degree. This point is borne

Fig. 9.

out by the progress of three young children who acquired their hearing aids at the age of 5, 4 and 3 years respectively.

A little 5-year-old girl, who was referred to us for study and help, had a vocabulary of some 30 words which she recognized through lip-reading and could say imperfectly, and a hearing distance of one foot from her better ear and none from her poorer ear (see Fig. 8). She made a rapid adjustment to a hearing aid in her better ear, wore it to kindergarten for six months, and with the help of her mother and teacher (she came from too great a distance to come for weekly clinic training) built up her speech and language almost to her age level (see Fig. 9). Now, at $7\frac{1}{2}$ years, she

is completing the second grade, and in reading and vocabulary is a year ahead of her group, as shown by our school achievement tests. Her speech is entirely intelligible, and she carries on a conversation with ease. Her auditory word images are so firmly fixed that she was able to write the words coming over the loud speaker without difficulty and with only a few mistakes. She is so eager to hear everything



AUDIOGRAM OF A CHILD WHO HAS WORN A HEARING AID IN HIS BETTER EAR CONSTANTLY FOR ONE YEAR, AND WHO IS EXPECTED TO PROCEED TO FIRST GRADE NEXT YEAR WITH HIS AGE GROUP.

RIGHT EAR •———•, LEFT EAR x - - - - - - - x

Fig. 10.

that she wears her aid every second of the day and never wants to turn it off. With an aid from almost the beginning of her speech-language development, she has practically natural use of her hearing. She has had lip-reading instruction for two years, and is an excellent lip-reader, but insists on using her aid at all times. Psychometric evaluation places her in a high normal or superior group, but without the help of an aid before entering school she would necessarily have been placed in a school for the deaf.

A 4-year-old boy, with a hearing distance of only a few feet in his better ear (see Fig. 10) has also made an excellent adjustment to his hearing aid, which throughout this year

he has been wearing the entire day—at kindergarten (see Fig. 11), at home and even for outside play. He had a fair flow of language in the beginning, but both speech and lan-

Fig. 11.

guage have greatly improved with the use of his aid and work with a clinic teacher last spring and summer. His

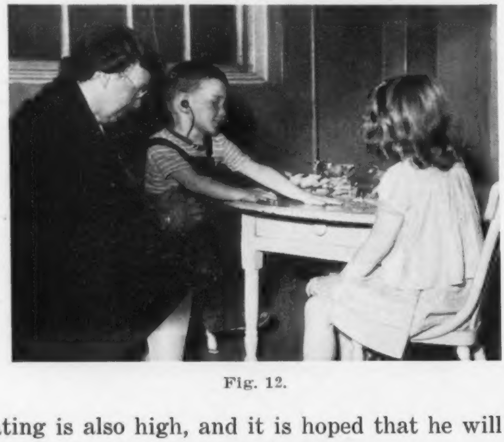


Fig. 12.

I. Q. rating is also high, and it is hoped that he will proceed satisfactorily in first grade next year.

During the past year an aid was placed on a young boy a

month before his fourth birthday. He has worn it constantly in nursery school and at home since last January, and has come to the clinic once a week for work with a special teacher

Fig. 13.

in speech development, listening and lip-reading. He has progressed from a vocabulary of some 25 words to a sizable

Fig. 14.

vocabulary, and he is now combining words in sentences. It is hoped that by continuing such a program a second year, he may then be ready for first grade. He is shown with a little 4-year-old girl, who has also made excellent adjustment

to an aid, having acoustic training (see Fig. 12) and practice in speech development (see Fig. 13).

The youngest to start out with an aid is a little girl just over 3 years of age, who has only a small vocabulary to start with, but her voice is so natural and the few words are spoken

Fig. 15.

so well that we hope she will make rapid progress. She is shown trying a hearing aid for the first time (see Fig. 14) and having her first psychometric test (see Fig. 15).

Hearing aids have been placed on 14 children during their preschool years. Of this number, three are now proceeding in regular classes in public school, with the help of lip-reading instruction which most schools offer; two entered schools for the deaf. Of the nine who are still in preschool status, there is the expectation that five, possibly six, may enter regular classes in public school when the time comes, and that

three, possibly four, will definitely go to a school for the deaf.

Part of the purpose of our clinic program for the habilitation of the preschool child has been a re-evaluation of the criteria for school placement on the basis of the child's potential corrected hearing. This could be done only with a small group of children under close observation during their period of adjustment and training. The main purpose of the preschool program, however, has been to give partially deaf children, with evidence of useful residual hearing, an opportunity to use an aid during their preschool years, which is the only time when they can learn to use their hearing in a completely natural way.

SUMMARY.

1. With the possibility of better hearing through the vacuum tube hearing aid, children with irreversible hearing handicaps call for expanded clinic programs as never before.

2. In recognition of this new need, a program of rehabilitation has been developed at the Massachusetts Eye and Ear Infirmary as an integral part of a clinical research program on deafness at the younger age levels.

3. The individual child is studied from the standpoint of general health, mental development and school achievement, special disabilities in hearing, speech and language, and social adjustment to his handicap.

4. On the basis of such studies, an individualized program is outlined, including recommendation of hearing aid, clinic training in use of aid, better listening habits, lip-reading combined with better hearing, and speech correction, whenever such facilities are available.

5. Hearing aids have now been placed on 100 children, ranging in age from 3 to 18 years, and including 43 children with conduction deafness, 19 with partial high tone deafness, and 38 more with marked nerve deafness.

6. Criteria for the recommendation of hearing aids and other remedial measures and the results obtained are given separately for each group.

7. The importance of the earliest possible habilitation of the preschool child and his educational placement on the basis of his maximum potential hearing is emphasized by the results obtained in three young children.

CERTAIN FUNDAMENTAL PRINCIPLES IN PRESCRIBING AND FITTING HEARING AIDS.

L. A. WATSON,

Minneapolis.

The accepted method of solving problems in any branch of science is one of separating and isolating the various factors involved, measuring them accurately in their basic form, and through analysis producing a definite plan for solution. The study and correction of hearing defects should be approached like any other field of science or form of physical therapy.

The Analytical Approach to Hearing Problems:

For analysis, modern electroacoustic techniques must be employed. The audiometer with its precision measurement of hearing loss through the frequency range offers the most reliable method for evaluating and analyzing hearing impairments and prescribing and fitting hearing aids.

Spoken voice and intelligibility tests have been recommended by some as the basis for prescribing and fitting hearing aids. A short test by spoken words or sentences is a less reliable basis for evaluating hearing or prescribing a hearing aid because it is only a test of how well one subject hears one particular voice pronouncing certain words under particular acoustic conditions. The first and most obvious source of error is the considerable variation in the sound power of different individual voices. Colpitts[1] shows that 7 per cent of the speakers tested speak with only one-sixteenth the sound power of the average speaker, and 4 per cent speak with from four to eight times the average power.

Another equally obvious source of error, astonishingly disregarded by many, is the attenuating or modifying effect of the acoustics in the room used for tests. Test rooms which

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, June 1, 1944.

have been used in recently reported studies of whisper and spoken voice testing are veritable "whispering galleries" in which the whispered voice at 20 feet is almost as loud as at two feet: This is because closed rooms of small volume, unless specially designed and treated as acoustic laboratories, tend to confine and reflect the sounds. The law that sound varies inversely as the square of the distance does not apply in such rooms as it does in open air. For this reason, varying the distance cannot be used in any ordinary room as an accurate means of measuring the degree of hearing loss. Speech and intelligibility tests, with a controlled microphone speech circuit or phonograph reproducer, can serve as a valuable adjunct to the more analytical pure tone type of test, mainly because they use the greater accuracy possible with electrical attenuation.

There are further sources of variation in speech articulation and intelligibility tests: Wide variations in the sound power of different speech elements, differences in enunciation and articulation of the speakers, and varying degrees of language aptitude in the subjects. Whisper or voice tests, unless delivered through a single earphone, may fail to separate the response of one ear from the other. This means failure to determine correctly the needs of the one ear to be fitted apart from the other. Occluding one ear with the finger or other means may produce a still different set of conditions in which certain frequencies are attenuated and others only slightly reduced in intensity.

The Neglected Factor of Effort and Fatigue in Hearing:

A factor which renders any brief list of words or sentences misleading as a test of hearing is the ability of the ear to accommodate for wide deficiencies in loudness, limited frequency range, distortion or other defects for short periods of time. The eye with a certain amount of added effort can read a printed page under substandard illumination. Yet no one would say that the illumination was satisfactory or visual acuity normal merely because the subject had succeeded in reading a page of text correctly. Similarly through a distorted or misfitted lens one can by increased effort read a page of text or name a series of objects correctly. Yet no

one would pretend that such a lens was acceptable for that reason.

Persons with normal hearing can generally understand speech in an auditorium with poor acoustics even though they are annoyed by reverberation. They would generally score well in a brief intelligibility test, though they would have to make an effort much greater than that necessary to understand the same words under favorable acoustic conditions. Acoustical engineers are well aware that the constant effort necessary to understand speech under poor acoustic conditions leads to fatigue. They would not insist that the acoustics of an auditorium were acceptable merely because a number of subjects made an excellent score during an hour's speech intelligibility test. They would proceed instead to make careful acoustic measurements independent of human speech and the accommodation powers of the ear. The basic data obtained would be used to formulate a plan for correcting acoustic conditions in the auditorium.

The accepted precision audiometer provides a means of separating the many constituent elements of hearing and measuring and analyzing them independently of the language factor and the accommodative powers of the ear. The microphone speech circuit of the modern precision audiometer, with its accurate decibel attentuator, permits the use of speech intelligibility tests as an adjunct to the pure tone audiometric tests. An excellent speech intelligibility test involving words or sentences with attenuator control may reveal the difference between a very inferior or badly distorted hearing aid and an excellent one. It cannot be depended upon to reveal the difference between a fair and a superior hearing aid fitting. It measures only whether the subject understands or not without measuring *how easily* he understands.

Evaluating the Effort and Fatigue Factor:

To evaluate the factor of effort and resulting fatigue with a speech intelligibility hearing test, it must be given with laboratory care and exacting technique. Hours, not minutes, are required. First a careful individual pure tone audiogram

is made. Then a standard speech intelligibility test is begun which involves both sentences and random test words. These are delivered through a high fidelity transmission system at controlled intensity level. The material of the test is divided into 10-minute periods of equal speed of diction and difficulty of text. The loudness of the speech reproduction in the laboratory test room should be adjusted to the most comfortable level for the average normal hearing person seated in the room. This will generally be between 60 and 70 db. above threshold of audibility. If the loud speaker were turned up to an intensity level higher than this, it would tend to give misleading test results.

The subject to be tested with a fitted hearing aid is allowed to adjust the instrument at the start of each hour of test to what he finds the most comfortable level of loudness. The score for each 10-minute period of testing is graded and graphed to indicate any progressive lowering of score from fatigue in successive periods. At the end of three hours, another pure tone audiometer test should be given. Any lowering of auditory threshold for pure tone is a symptom of fatigue. A steady downward trend of the intelligibility score through successive 10-minute periods of test also indicates fatigue. Three or four hours of testing will generally reveal the fatigue element in a very inferior or badly fitted instrument. It may take eight hours or the equivalent of a full day's use to reveal the difference between a moderately good instrument and a superior one excellently fitted to the subject's needs. In addition to the recorded graph of his speech intelligibility-time curve, the subject's own reactions and impressions during the test should be solicited and evaluated. Any sense of straining or effort should be noted.

Only by such exacting speech intelligibility-time test methods can the effort and fatigue factor be evaluated. An inferior or improperly fitted hearing aid which is satisfactory for short speech tests is shown up in the period of hours that more nearly represents normal use. Obviously the physician has neither the time nor the laboratory facilities to conduct such thorough tests. He must consequently base his diagnosis and his prescription on the study of hearing fundamentals

made with the audiometer, supplementing this by a general personal investigation of the methods and results achieved by various available instruments. There are a number of definite, practical principles to guide him in prescribing a corrective hearing aid fitting from his audiometric examination:

Who Needs a Hearing Aid?

There are certain definite limits below which a hearing aid is generally not needed. According to the American Medical Association table for evaluating percentage of hearing

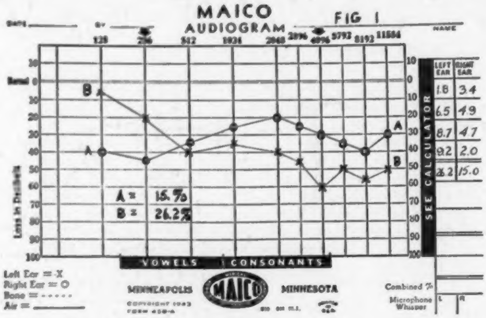


Fig. 1. American Medical Association percentage of hearing loss table applied to two cases.

loss,[2] a loss in decibels may be translated into "percentage of loss for speech." Experience reveals that a loss on the better ear of 25 per cent or more according to this table generally necessitates the use of a hearing aid. Fig. 1 illustrates the better ears of two different subjects. "A" does not need a hearing aid; "B" does.

An even simpler method of determining from the audiogram whether a subject can lead a normal life without a hearing aid is to examine the most essential area for speech interpretation, the tonal area from 1,024 to 2,896. Fowler[3] gives these two frequency areas, representing 1½ octaves, a value of 55 per cent of all the important sounds of speech. Because of the greater sound power of vowels and other speech elements in the lower frequency range (256 to 1,024), an impairment for these lower tonal areas is generally not

so severe a handicap as an impairment in the higher range from 1,024 to 2,896 cycles where many of the important but weaker consonant elements of speech occur.[4]

In this most critical area from 1,024 to 2,896 cycles, the level of hearing loss at which a subject's handicap for speech in daily life becomes sufficient to require the use of a hearing aid is the level between 30 and 40 db. above threshold.[5,6] Beasley[7] shows impairment for public address beginning slightly below this level and impairment for direct conversation in this level.

In Fig. 2, Case A (better ear only) can get along without a hearing aid, although his impairment at first appears to

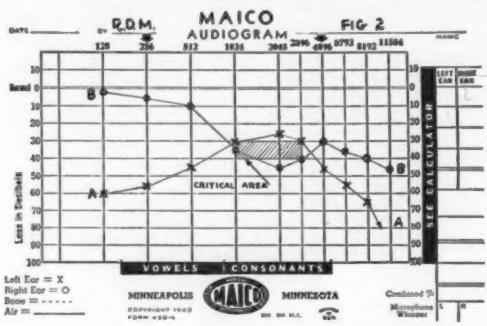


Fig. 2. Critical Area of the audiogram for speech and use of a hearing aid. Two cases.

be worse than that of Case B (better ear only). "B" needs a hearing aid in spite of apparently good hearing in the lower tonal range. He will hear spoken voices without difficulty but will have great difficulty in understanding speech because of loss in the critical area from 1,024 to 2,896.

If no recruitment is present, an individual may require a hearing aid when the curve of the better ear first enters this critical area of the audiogram, reaching the 30 db. level. If recruitment is present, as it is in many nerve types of deafness, a hearing aid will usually not be needed until the whole of this critical area of the audiogram is lost to the better ear.

This critical area of the audiogram is so important in determining whether or not a hearing aid is required that

some otologists today use audiogram forms in which this area is indicated by shading. The physician will do well to consider this critical area always in advising his patients on the need of a hearing device.

Who Can Be Benefited by a Hearing Aid?

The American Medical Association table for converting audiometric decibel loss into percentage of loss for speech shows a total loss of serviceable hearing (cf. Fig. 1) at 90 db. from 512 to 1,024 and at 95 db. from 1,024 to 2,048. Such losses are extreme and excellent hearing cannot be supplied to any individual with losses in excess of these levels even by

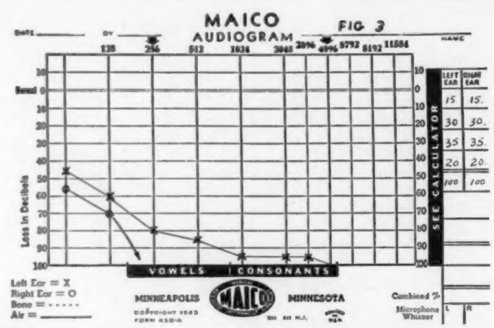


Fig. 3. Case of audiometric total "loss" by American Medical Association table, successfully wearing hearing aid.

the finest hearing aids. Yet, today there are many hard-of-hearing persons with losses at 90 db. at 1,024 and 95 db. at 2,048, wearing the best modern hearing aids, who are able to carry on direct conversation and can understand normal speech fairly well at distances of 5 to 10 feet or more. Fig. 3 illustrates such a case whose hearing for normal conversational voice through the hearing aid is 10 feet.

There are, however, certain maximum limits of hearing loss beyond which the finest hearing aids available can be of no value. If the American Medical Association table is somewhat conservative in its evaluation of total loss of serviceable hearing, it is nonetheless very close to the absolute maximum limits. Hearing aid experience shows that with very rare exceptions, persons with a loss of 100 db. or more

at 1,024 and 2,048 can get no practical intelligibility through the use of even the finest hearing aids. There is a little residual sensation left in such extreme cases between the 100 db. loss level at threshold and the "threshold of pain or feeling." Sound in this range is so intense that it seems beyond the capacity of the auditory apparatus and the brain to understand speech received at such extreme intensities.

A powerful hearing aid used by such an extreme loss case serves only to provide a partial key to the phrasing, timing and pitch of the speaker's voice. Real understanding and

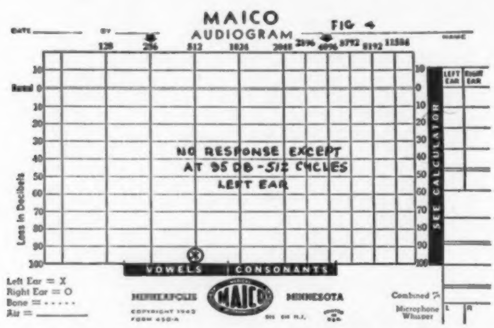


Fig. 4. Case beyond the range of any hearing aid, wrongly fitted.

intelligibility cannot be obtained through the use of a hearing aid alone and lip-reading training should be recommended.

It is safe to say that no individual with a loss greater than 95 db. at 1,024 and 2,048 should be fitted with a hearing aid unless he fully understands the limited if not doubtful benefits which he can expect from it. Fig. 4 illustrates the dangers of fitting hearing aids without prior examination and audiometric study. The individual whose audiogram is shown in Fig. 4 has no hearing left whatever at 1,024 and 2,048, and 95 db. of loss at 512. According to the American Medical Association Percentage of Loss for Speech table, no hearing aid could possibly provide him with more than 15 per cent of the important sounds of speech, since he has no residual hearing in the range from 512 to 4,096 representing 85 per cent of the important speech sounds; yet he was fitted to a

hearing aid without benefit of audiometric examination. No results were achieved.

There are other conditions besides extreme loss which make the benefits from a hearing aid doubtful or limited. Fig. 5 illustrates an unusual "U"-shaped curve which generally presents complications in perceptive and interpretative abilities. Great care and patience is necessary in fitting such cases, and often the best possible results will be limited. It is particularly necessary for the otologist to explain to a patient suffering from such an impairment that perception and understanding of speech will be much more difficult for him than for those with most other types of hearing loss, and that his close cooperation and patience will be needed.

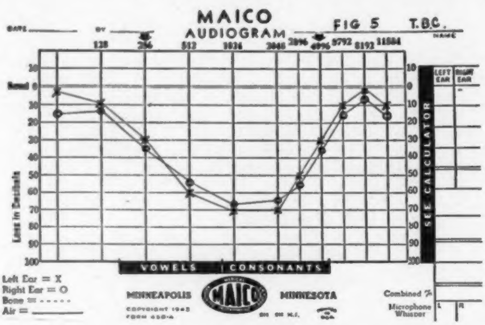


Fig. 5. "U"-shaped audiometric curve involving interpretative difficulties.

There are other special types of hearing impairment which cannot be benefited by even the finest hearing aid, although these represent probably less than 3 per cent of the total number of cases of defective hearing. Fig. 6 shows a case in which hearing acuity is so nearly normal up to 1,024 cycles that any amplification is unnecessary. Above 1,024 there is a sudden and complete cut off of hearing, leaving no residual hearing at 2,048 and higher frequencies. Obviously in the lower part of the hearing range the loss is not great enough to require an aid. In the higher part of the range the loss is so complete that an aid would be of little benefit.

When to Fit the Better or the Poorer Ear:

One of the primary objectives in a hearing aid fitting,

often completely missed without a careful audiometric analysis, is the failure to give the subject the benefit of what binaural hearing effect he might enjoy. Fig. 7 shows a case wrongly fitted to a hearing aid on his left ear. It is the better ear through most of the frequency range, and it was considerably easier to give this individual a strong reproduction of sound for the limited frequency range (900 to 1,800 cycles) available in a hearing aid of poor performance.

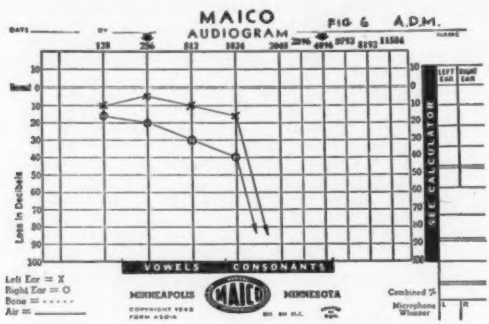


Fig. 6. Audiometric record on case where hearing aid is of no benefit.

The better ear falls off sharply above 2,048 cycles while the poorer ear has an extended range in the higher tones. If the subject were fitted on the poorer or right ear, he would:

1. Profit by amplification of some 30 per cent of all speech sounds which he would get either poorly or not at all on his left ear.

2. Because of the moderate loss in his left ear throughout most of the frequency range, he would get a substantial amount of benefit from it without any aid. Adding to this the better hearing provided by a fine hearing aid on the poorer or right ear, he gets a fair degree of binaural hearing.

Binaural hearing always improves hearing ability remarkably even where only a small amount of actual hearing is provided by one ear. It permits easier localization of sounds, and facilitates discrimination, selectivity, and concentration in the presence of poor acoustics, masking noises and other interferences. To appreciate this, a person with two normal

ears needs only to stop up one of his ears while listening to a speech in a hall with poor acoustics.

PRINCIPLES IN THE SELECTION OF EAR TO BE FITTED.

There are certain definite scientific principles that determine when to fit the better ear and when to fit the poorer ear, or which ear to fit when the two ears are alike in threshold curves:

1. If the *better ear* has a loss of less than 50 db. in the most essential tones of the speech range (512 to 2,896), fit the *poorer ear* if good results can be obtained on that ear.

2. If the *better ear* has a loss of more than 50 db. in the essential speech range, the better ear may be fitted because

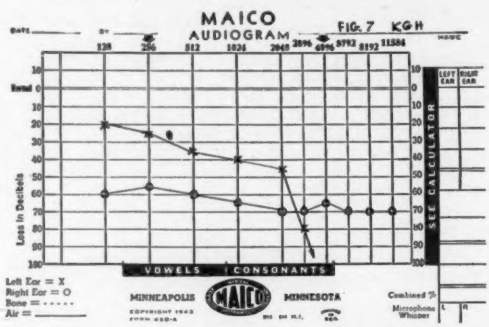


Fig. 7. Case originally fitted on better ear.

it is of almost no direct benefit without a hearing aid and no binaural advantage will be obtained through fitting the poorer ear.

3. If the poorer ear has a severe loss of over 75 db. or has a limited frequency range, or exhibits very poor ability to interpret and understand speech, the *better ear* may be fitted even though the loss on the better ear is less than 50 db.

4. If the threshold curves of the two ears are nearly identical, it is well to fit the ear which has the best perceptive and interpretative ability. The factor of recruitment is also important. Recruitment at lower intensity levels is an advantage to an ear. An ear with 50 db. or less of loss which has

1177

a strong initial recruitment just above threshold should be left unfitted and the other ear with less recruitment fitted. This is particularly indicated where the MCL (Most Comfortable Loudness Level) is not too far above threshold LCL (Lowest Conversational Level).

Where the MCL is at a high level above threshold or LCL and there is a narrow range of comfortable loudness around this point, recruitment is apt to be a disadvantage to an ear

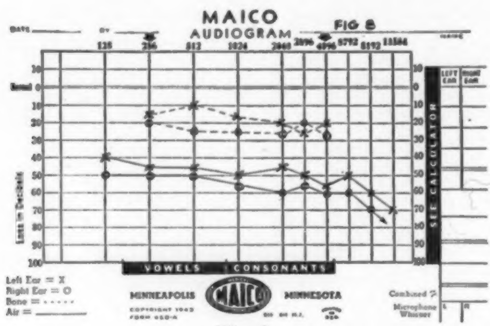


Fig. 8.

because it tends to bring sounds against the Threshold of Pain or ULL unless strong suppressive action is provided.

Air Conduction and Bone Conduction:

Although bone conduction receivers were popularized with the earlier carbon type hearing aids, their use with the vacuum tube type instrument is much more limited. In the carbon type aids there was little or no reproduction of sound above 1,800 cycles, so that bone conduction receivers, none of which have much response above 2,000 cycles, did not deprive the user of a wider high frequency reproduction available in the finer type vacuum tube aids.

The limitations of bone conduction receivers today are that they tend to give strong emphasis in the lower and middle frequency ranges, but poorer reproduction in the higher consonant range from 1,800 to 3,000 cycles where many hard-of-hearing individuals most need corrective amplification.

Beasley[6] noted that among deafened individuals bone conduction was often greatly increased in the lower and middle tones but reduced for higher tones where correction was most needed. He suggested that an effective bone conduction aid would have to produce "zero gain for tones below 1,000 cycles and about 35 db. for tones above 3,000 cycles." All available bone conduction receivers have quite the opposite characteristic.

Since the operation of a bone conduction receiver requires substantially greater power than the usual air conduction

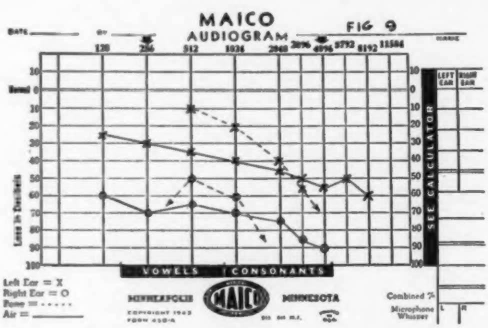


Fig. 9.

receiver, bone conduction should be used only where there is an increase of at least 30 db. in the bone conduction curve over the air conduction curve from 512 to 2,896 cycles. Where bone conduction is increased in the lower or middle tones but falls off sharply at the 2,048 or 2,896 cycle levels, the tendency will be to deliver overemphasis of the vowel and middle range speech sounds which will tend to "mask out" or obscure the consonant sounds needed for articulation and intelligibility. Figs. 8 and 9 illustrate two different cases. That of Fig. 8 may be fitted to a bone conduction type receiver, although he will hear almost as well with an individually fitted air conduction receiver. Fig. 9 illustrates a case in which bone conduction was not recommended because of overemphasis of the low-pitched area and decrease by bone conduction in the high tones.

Above Threshold Tests for Comfortable Loudness and Recruitment:

In addition to its use in evaluating the threshold hearing curve of the individual, the audiometer may be used to evaluate the condition of hearing at levels above threshold. It is well known that two individuals with similar threshold audiograms may hear differently at levels well above threshold. Loudness balance tests for recruitment can be made to determine a change in rate of loudness perception where the two ears are markedly different in threshold curves; but where the two ears are nearly alike at threshold, the factor of recruitment cannot be so evaluated.

The microphone speech circuit of the audiometer offers a quick and convenient means of evaluating hearing condition above threshold, and it has particular value in the prescription of a corrective hearing aid. An ear having a strong recruitment may have a loss at threshold of 50 db. yet at 90 db. the sounds will be perceived with the same sensation of loudness as by a normal ear. For a case without recruitment, a 90 db. sound would be softened by approximately the amount of loss shown at threshold. This means that for the nonrecruitment case the 90 db. loud sound would be perceived more like a sound of 40 db. to a normal ear.

The physician can detect the presence or absence of recruitment by the use of the microphone speech circuit. The procedure is as follows: Holding the microphone at a uniform distance of approximately two inches from the lips, the physician should repeat random words such as names of cities in a normal conversational voice directly into the microphone grill. The subject under test should not be allowed to watch the face or lips. While speaking, the operator shifts the Hearing Loss Control of the audiometer to find:

1. The lowest level in decibels at which the subject can repeat the test words. This level may be indicated arbitrarily from the decibel control of the audiometer at Lowest Conversational Level—*LCL.*

2. The operator next turns the Hearing Loss Control up to the point which the subject pronounces as the Most Comfort-

able Level—*MCL,* loud enough to be easily audible yet not uncomfortably loud. This also is noted in decibels from the Hearing Loss scale.

3. The operator should note carefully over how wide a range he may shift the Hearing Loss Control and still have the spoken voice loud enough to be easily audible and test words repeated—yet not exceeding the limit of tolerable loudness at the upper end. This range between lowest level at which conversational voice can be repeated and the point at which it becomes disagreeably loud and painful should be noted as the Range of Comfortable Loudness—*RCL.*

4. A final point may be noted as *ULL,* Uncomfortable Loudness Level—the point at which the sound becomes painful to the subject.

This information may be obtained with relative ease and does not require a great deal of time. It is realized that the voices of different operators will vary widely and that the specific level of loudness at which the same subject might first be able to perceive speech of the same operator would vary; however, the relative information obtained by this microphone speech test is still valuable. The RCL or Range of Comfortable Loudness provides an excellent indication of the presence or absence of recruitment. Most individuals with conductive type of deafness will show, like normal hearing persons, an RCL as wide as 25 and 30 db. Over this range of loudness the sound will be understandable and completely comfortable to them.

Many persons with perceptive or nerve types of deafness, however, will show an extremely narrow range of comfortable loudness. In Fig. 10 one ear of each of two different persons is shown. The audiometric threshold curves are not dissimilar. Yet "A" has a range of comfortable loudness of 20 db. and "B" has an RCL of only 5 db.! "B" stated that through the microphone speech circuit of the audiometer the sounds were "not quite loud enough" at 80 db. but were painful at 90!

A narrow range of comfortable loudness indicates that

sounds become louder more rapidly than for the normal ear — in other words, recruitment. Fowler and others[9] have described recruitment, but it has generally been measured by the loudness balance testing method. The microphone speech circuit offers a convenient method of evaluating recruitment and provides an important indication of the type of amplification most suitable to a corrective hearing aid fitting. Where an individual has a very sharp and narrow range of comfortable loudness (RCL), a strongly suppressive type of amplifier should be selected. This is because he has

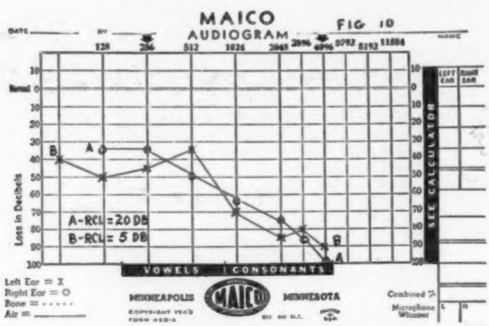


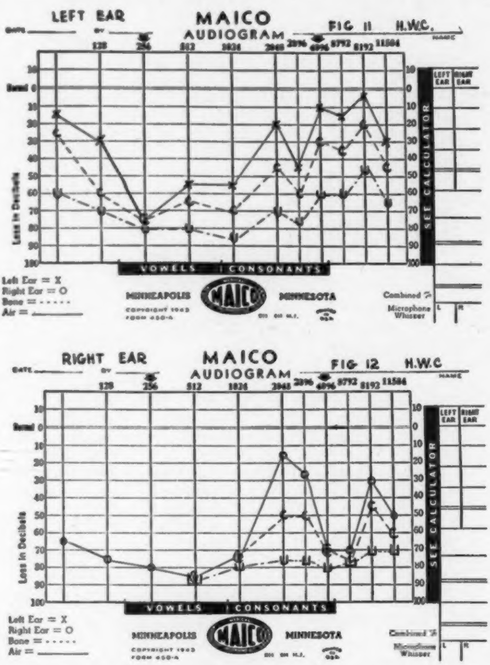
Fig. 10. Two contrasting cases—threshold curves and RCL.

a very narrow range of loudness within which speech sounds should be heard. A subject who has a wide range of comfortable loudness as great as 20 or 30 db. by the microphone speech circuit should have and generally hears best with a nonsuppressive type of amplifier which amplifies the loud sounds comparably to the fainter sounds.

MCL or the Most Comfortable Loudness Level as measured through the microphone speech circuit of the audiometer is also a valuable guide mark in the selection of a hearing aid fitting. If the MCL is relatively low on the Hearing Loss Control (40 to 60 db.), an instrument with moderate gain and power output will suffice, regardless of the threshold curve. If the MCL is high (from 75 to 85 db. or more on the Hearing Loss Dial) an extremely powerful, high gain type of amplifier is indicated.

Comfortable and Uncomfortable Loudness Tests by Pure Tone Through Frequencies:

In addition to the microphone speech circuit and spoken voice as a means of evaluating hearing condition at levels above threshold and recruitment, the tones of the audiometer may be used effectively to measure the available range of usable hearing. Figs. 11 and 12 show the threshold audiograms on the left (Fig. 11) and right (Fig. 12) ears of a



Figs. 11 and 12. Threshold, comfortable loudness and uncomfortable loudness curves on each ear—nerve involvement.

woman having an unusual type of hearing impairment with marked recruitment. Range of Comfortable Loudness on the left ear for speech as determined through the microphone speech circuit was 15 db. On the right ear it was less than 10 db. It is interesting to note that on the right ear at 1,024 cycles, there is only 5 db. between: *a*. Threshold Curve,

b. Comfortable Loudness, and *c*. Uncomfortable Loudness. Actually, her threshold and uncomfortable loudness levels are so close that she has no range of comfortable loudness. It was impossible to give this woman any usable amplification at 1,024 cycles. The left ear was necessarily fitted and shows a wider divergence between the threshold, comfortable loudness and uncomfortable loudness curves.

Changing the Frequency Characteristics of Hearing Aids to Suit Individual Needs:

It has been indicated previously that hearing aid amplifiers are supplied by some manufacturers in suppressive and

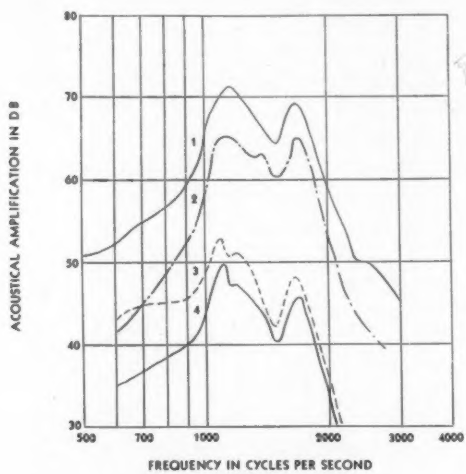


FIGURE 13

Fig. 13. Effect of four positional tone switch in one make of hearing aid.

nonsuppressive types to suit different types of deafness involving or not involving recruitment. This is necessarily done with two or more different types of transmitters (the amplifier-microphone combination of the hearing aid). Some manufacturers make certain different types of transmitters available to give different frequency emphasis. Others provide frequency variations by means of: tone controls, switch controls and other devices. A review of the several different

methods of changing the frequency response characteristics of a hearing aid to provide corrective fittings would show:

1. Different transmitter amplifier units. Wide variations can be accomplished by this method with precision engineering; however, an adequate variety of different combinations is prohibitively expensive to achieve by this means alone and creates such a stock problem that most manufacturers using this system limit available types to two or three.

2. Tone Controls — Manually operated or by set switch. These may consist of a simple variable resistor such as is used in most radios (in this case they generally provide little

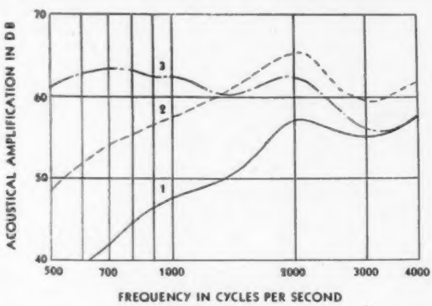


FIGURE 14

Fig. 14. Effect of three positional tone switch on another make of hearing aid.

if any real modification of the frequency response character of the instrument); or they may consist of a small rotary switch with from two to four positions which create more or less change in certain circuit values. Figs. 13 and 14 illustrate two extremes in this type of control. In Fig. 13 almost no real change of frequency characteristic is accomplished with four different settings of the "tone control." This control actually reduces the volume or loudness more than it alters the frequency characteristics.

Fig. 14 illustrates another manually operated rotary tone switch in which a substantial change is accomplished in the lower and middle range tones. In most hearing aids the amplification curve is merely depressed more or less in the tones below 1,000 cycles.

There are proponents of the "manually operated tone control" who claim that it permits the user to change his hearing character to suit the acoustics of the room in which he happens to be. Those favoring a set adjustment of frequency state that no normal hearing person needs to "tune his ears" depending upon just what he happens to be listening to, and that continual tampering with the controls of a hearing aid not only indicates a failure to make the proper corrective individual fitting but proves embarrassing to the hard-of-hearing user.

Note that effect is one of change of intensity with little shift in frequency response emphasis. Curves numbered one

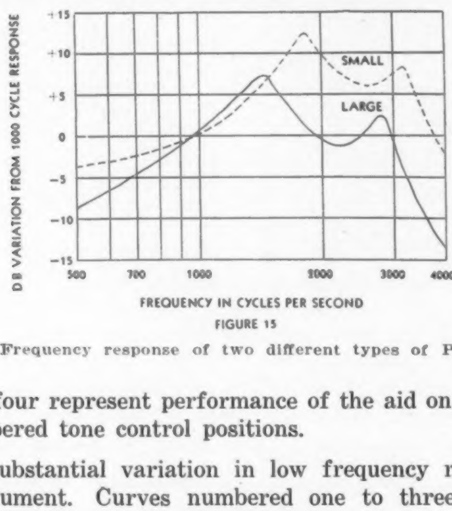


FIGURE 15

Fig. 15. Frequency response of two different types of Piezo Electric Receivers.

through four represent performance of the aid on the different numbered tone control positions.

Note substantial variation in low frequency response of the instrument. Curves numbered one to three represent effect of different tone control settings.

3. Changes in receiver. This is one of the most efficient methods of changing frequency emphasis in that it shifts the emphasis more by accentuation than by attenuation. Fig. 15 illustrates the difference in frequency response between two different types of Piezo Electric Receivers tested separately. The smaller of the two has greater high frequency emphasis — exactly the reverse of the values given by one medical investigator.

Variations in frequency emphasis are here shown not on an absolute scale but in reference to the amplification provided at 1,000 cycles (1,024 on the audiometer). For hearing aid purposes this is the best method of showing selective amplification because it shows balance and relative emphasis above and below the center of the speech range. The user of a hearing aid adjusts the instrument in any case to the comfortable loudness level. The relative amplification indicates best whether or not the amplification pattern conforms to his particular type of loss.

Note that the smaller of the two receivers has substantially greater high frequency emphasis than the larger of the two.

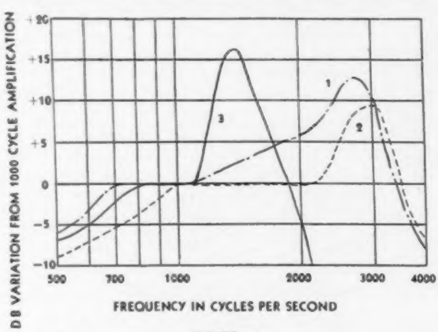


FIGURE 16

Fig. 16. Different frequency response characteristics obtained with different types of microphones.

The curves show relative frequency response, not absolute output.

4. *Changes in microphones.* This permits a shift in peaks of emphasis as narrow as an octave in width or less. Only one or two makes of hearing aids are designed so that different types of microphone may be used to vary the frequency response curve. Fig. 16 illustrates variations in response curves which may be obtained by the use of different types of microphones.

Curves numbered one to three show the effect of three different microphones on the same transmitter-amplifier unit.

5. *Changes in frequency by set screw adjustments.* One

device uses a whole series of different set screw adjustments which permit a wide variation in frequency characteristics as shown in Fig. 17 plus a means for matching the output impedance of the transmitter to suit different types of receivers. This permits still further variations and shifting of frequency emphasis by allowing the use of both Piezo electric, magnetic and dynamic type receivers. It is interesting to note how sensitive most hard-of-hearing persons are to

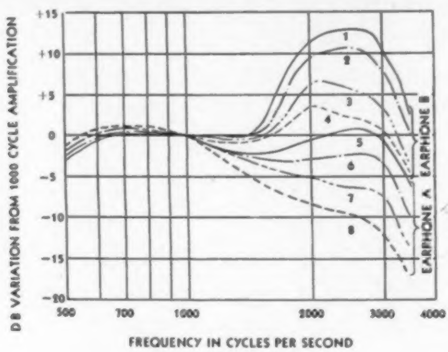


FIGURE 17

Fig. 17. Different frequency response characteristics obtained in corrective hearing aid fittings by set screw adjustments.

changes in frequency emphasis as low as 5 db. over a range of one octave or less. This is particularly true with the perceptive and nonlinear types of deafness.

In selecting a corrective adjustment, emphasis should be given to the deficient frequency areas in the speech range from 500 to 4,000 cycles. A high quality vacuum tube hearing aid will provide a range of 4,000 cycles. An inferior one may be limited to 1,000 cycles of useful amplification. Where an individual suffers a total loss of hearing at any frequency (100 db. or over) no attempt should be made to provide correction at that frequency since there is no useful residual hearing to profit by it. Correction must then be limited to the frequency range where residual hearing is available.

For example, an individual with an 80 db. loss at 512 and 1,024 cycles and total loss above this point will hear best with an instrument peaked around 800 to 1,400 cycles with little pressure at higher levels. But if the same person had

a 90 db. threshold at 2,048 and 95 db. at 2,896, an instrument giving strongest reproduction around 2,000 cycles would be more helpful.

The Rôle of the Otologist:

The physician is in a peculiar position to advise and assist his patient in the selection and fitting of a hearing aid and subsequent adjustment to it; first, because of his knowledge of the patient and his personal psychology; second, because of his professional position and the realization of the patient that he has no commercial or selfish interest in the matter. The physician can be particularly helpful to his patient in a frank discussion of his problems, what his residual hearing condition offers in the way of rehabilitation through a hearing aid, and the necessity for personal adjustment to the idea and the physical and psychological problems of wearing a hearing aid. The physician can impress upon his patient the necessity of cooperation on his part in rehabilitating his hearing through the use of an instrument. Too often in the past, hard-of-hearing persons have been led to believe that a hearing aid was a quick and easy miracle that provided instantly everything its wearer hoped for. Even the finest instruments require a period of adjustment and adaptation before the user begins to get anything like optimum results.

Day[10] estimated that 75 per cent of all hearing aids sold were not worn regularly after purchase. Hughson[11] disagreed with this on a basis of a detailed study and found that 71.3 per cent of the purchasers of hearing aids questioned were using them regularly. Perhaps Day's figures are overpessimistic, even in terms of the vastly inferior carbon type of hearing aids prevailing at the time of his study. It is certain that there is a wide variation in ratio of hearing aids in regular successful use to the number actually sold today. In direct proportion to the quality of the instrument, the care and accuracy in individual fitting, and the personal service and attention given the user, particularly during the first few weeks of adaptation to the device, from as low as 4 per cent to as high as 50 per cent of all vacuum tube hearing aids sold are relegated to disuse. The physician can

evaluate the relative merits of different instruments and the fitting techniques used by questioning every hard-of-hearing patient on his hearing aid experience, finding out which devices and techniques produce the smallest number of failures. Any hearing aid which is not actually worn and in constant use may be considered a failure. A device which provides only a small part of the hearing correction and benefits to which an individual's residual hearing should entitle him is also a failure.

The fundamental difference between hearing aids and most other personal purchases which is overlooked today is that people generally do not want hearing aids, whereas they do want most other products offered to them. Hard-of-hearing persons are extremely sensitive about wearing hearing aids, and often feel that wearing a hearing aid is an admission of advancing age or infirmity. A personal tragedy which the physician may do much to prevent is that of a patient who buys a hearing aid, is dissatisfied and abandons its use. To the disappointment of hopeful friends and relatives, such a "backslider" invariably answers: "You see? I told you it wouldn't help me."

Ninety-five per cent of all hard-of-hearing persons can be given excellent correction for their handicap today through a properly fitted hearing aid. Subconsciously many hard-of-hearing persons who "give up" during the first few days or weeks of adjustment to the wearing of a hearing device welcome someone's failure to follow through and see that they do use the instrument and are getting results from it. When the physician prescribes a hearing aid, he would wisely insist on a report from his patient and the hearing aid representative. If the patient is not using the aid regularly or is not getting the expected results from it, the physician can determine whether this is due to:

1. Lack of sincere cooperation and effort on the part of the patient.

2. Lack of personal attention, service or proper fitting by the hearing aid representative.

3. Shortcomings in the device itself, such as distortion,

limited frequency range, extraneous noises, insufficient amplification, etc.

Simply throwing his patient into the problem of selecting a hearing aid and obtaining a proper fitting with the suggestion: "Go try them all and find one that suits you" is apt to end in confusion and bewilderment of the patient. Day[12] comments: "Many an otologist loses interest in the management of his hard-of-hearing patients when he finds that they are not amenable to treatment and dismisses them with the suggestion that they try out some hearing aids. This is comparable to an ophthalmologist telling a patient with defective vision to try out some glasses."

Care and Preparation of Ear Canal:

The physician can safeguard his patient's residual hearing by his clinical examination of the ear canal and supervision or recommendations regarding the prosthetic ear insert which holds the midget receiver to the ear. Hughson[13] believes that the impressions or casts from which individually molded earpiece retainers are made should be taken only by the physician. Where the physician will take the time to study the mechanics of this technique and make the individual casts, it is advisable that he do so; but a large number of physicians who have attempted it have found it an irksome, messy and tedious task, and refuse to bother with it. This has necessarily resulted in dentists or technicians making these casts in many instances.

The physician can, however, study the ear canal of his patient, noting any sharp turns or "bottlenecks" which might make the use of plaster as an impression material difficult if not dangerous. He can insist on clearing up any infections or irritations before the cast is made, remove any impacted wax or foreign bodies, and trim any growth of hair. A perforated eardrum should be noted. The physician may, immediately before the cast or impression is made, coat the drum and interior of the ear canal with a bland oil. This is a necessary protection against any escaping plaster adhering to the drum or canal walls. He will do well also to protect the drum with a small cotton tampon.

If he does not make the cast himself, he should inspect the ear with his otoscope after removal of the impression. Later he should check the individually molded ear insert (prepared from the cast) for snugness and comfort of fit. Any points of irritation or pressure may be noted and marked with a request for the technician to buff the piece at such points.

Design of Ear Insert:

In nerve types of deafness it has been claimed that a wide diameter in the channel and orifice of the individually molded ear insert provides improved high frequency response. For several years it has also been a practice sometimes to drill a small "vent" hole 1/64-inch in diameter into the channel of the ear insert to reduce low frequency sounds where they produce a masking effect in nerve types of deafness. The same vent may also be necessary to permit drying and ventilation of a "moist" ear canal. Grossman[14] favors the wide channel in ear inserts for nerve deafened cases to such a degree that there is practically no extension of the insert into the canal. This is not regarded favorably by many electro-acoustic engineers, since the increased acoustic leakage seriously increases the feedback problem, already great enough because of the high frequency accentuation necessary in nerve deafened cases.

A new type of plastic impression material has been developed by one manufacturer eliminating the hazards of dental impression plaster used in the ear canal. This new material does not adhere to the walls of the canal and is easy to remove because of its elastic, almost rubbery nature. It is particularly effective in making casts of unusual shaped ear canals.

Continuing Supervision of Patient's Hearing Rehabilitation:

When the physician sees his patient well started on the road to hearing rehabilitation with a fine hearing aid, his interest and supervision of the patient's progress and welfare should not end there. He should watch and check the patient's residual hearing at least once each year for any recession or improvement. He can check on his patient often during the first few months to make certain that he is using his instrument, and that he is getting the close personal serv-

ice and attention from the hearing aid dealer necessary to his successful rehabilitation.

Improvement in the patient's ability *to use the sounds he hears,* interpretative facility, and capacity to understand speech in the presence of conflicting sounds and voices and masking noises can be checked. These things are acquired gradually by the patient. The physician may note any defects in his speech, even minor weaknesses in enunciation, at the time the aid is first fitted. Unless the loss is extreme or complete at certain frequencies, a correct fitting of an excellent hearing aid should correct in time any defects in speech directly attributable to hearing impairment.

Above all, the physician may supervise and assist in the psychological rehabilitation of his patient. For there is an unusual and peculiar psychology about deafness as pointed out by many physicians and psychiatrists, and the physician can play an important rôle in assisting his patients to overcome the psychological barriers of their affliction. He can help them to overcome their sensitivity about their affliction, their tendency to personal isolation and withdrawal, their irritability and suspiciousness due to the aggravation of knowing or hearing part of something but not all of it.

There is perhaps no serious human handicap today which can be so completely overcome by a corrective device as defective hearing; but the finest of hearing aids, like any other electromedical device, must have close personal attention and care of both a physical and psychological nature to insure successful rehabilitation. The help that the physician can render his hard-of-hearing patient is evident.

BIBLIOGRAPHY.

1. Colpitts, E. H.: Scientific Research Applied to the Telephone Transmitter and Receiver. *Bell Sys. Tech. Jour.*, 16:3:259, July, 1937.

2. American Medical Association. Tentative Procedure for Evaluating the Percentage of Useful Hearing Loss in Medical-Legal Cases. *Jour. A. M. A.*, 119:1108, Aug., 1942.

3. Fowler, E. P.: A Simple Method of Measuring Percentage of Capacity for Hearing Speech. *Arch. Otolaryngol.*, p. 874, Dec., 1942.

4. Fletcher, Harvey: Speech and Hearing, p. 74.

5. Steinberg, J. C.: Results of World's Fair Hearing Tests. *Bell Sys. Tech. Jour.*, 19:4:542, Oct., 1940.

6. Hughson, Walter: Lectures to American Academy of Ophthalmology and Otolaryngology, Oct., 1943.

7. Beasley, W. C.: National Health Survey, Hearing Study Series, Bull. 6, p. 25.

8. Beasley, W. C.: Partial Deafness and Hearing Aid Design. *Jour. Soc. Mot. Pict. Eng.*, 35:76, July, 1940.

9. Fowler, E. P.: Is the Threshold Audiogram Sufficient for Determining Hearing Capacity? *Jour. Acous. Soc. of Am.*, 15:1, July, 1943.

10. Day, Kenneth M.: Prescribing Hearing Aids. *Pa. Med. Jour.*, 43:1299, June, 1940.

11. Hughson, Walter, and Thompson, E.: The Hearing Aid from the Patient's Point of View. *Arch. Otolaryngol.*, 38:3:257.

12. Day, K. M.: (Opus Cit. of No. 9 above), p. 1299 et seq.

13. Hughson, W.: Cf. ref. No 10.

14. Grossman, Frederick: Acoustic Sound Filtration and Hearing Aids. *Arch. Otolaryngol.*, 38:2, Aug., 1943.

A COMPARATIVE STUDY OF WHISPER TESTS AND AUDIOGRAMS.*†

LIEUTENANT COLONEL JOSEPH L. GOLDMAN.

In recent years there has been a tendency among otologists to use the audiogram as the gauge of man's practical perception of the human voice. The improvement in hearing perception following the fenestration operations, for instance, has been reported usually in terms of hearing gain as determined by the audiometer.

I have had the opportunity to study a large number of audiograms of Army Air Forces personnel and to compare these readings with the perception of whisper tests and, to a lesser degree, of low conversational voice tests. In the course of many hearing examinations, the impression was obtained that practical hearing perception could not be measured routinely by air-conduction audiometric examination. An analysis of the audiometric and whisper readings revealed that there was no constant correlation between the audiometric average decibel loss and the recording of the whisper perception. The same deficiency was noted between the audiometric and low conversational voice tests. Similar impressions have been suggested in the writings of Shambaugh, Sr., Fletcher, Kerridge, Fowler, Sr., Wishart, Macfarlan, Hughson and Witting and others. It was thought, nevertheless, that a report on a large number of consecutive hearing tests, performed on men in military service to determine their hearing fitness, would contribute to this subject.

Both audiometric and whisper examinations were made routinely on a total of 167 men. In some instances the low conversational voice test was also used. The average decibel loss was computed by averaging the decibel loss for air conduction for 256, 512, 1,024 and 2,048 dv., which tones are supposed to include the speech range. The acuity of hearing

*Read at the Seventy-seventh Annual Meeting of the American Otological Society, Inc., New York, June 5, 1944.

†Technical Sergeant Edward J. Cuneo rendered valuable technical assistance in this work.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, June 15, 1944.

of enlisted men to the whisper was determined by the method prescribed by the War Department in "Standards of Physical Examination During Mobilization (Jan. 22, 1943)":

"To determine the acuity of hearing, place the registrant facing at right angles to the assistant, 15 feet distant, with ear to be tested toward assistant, and direct him to repeat promptly the words spoken by the assistant. If the registrant cannot hear the words at 15 feet, the assistant will approach foot by foot, using the same whisper, until the words are correctly repeated. Examine each ear separately, closing the other ear by pressing the tragus firmly against the meatus; the examiner may face the same direction as the registrant and close one of his own ears in the same way as a control. The assistant will use a whispered voice produced by speaking with the lungs in a state of complete exhalation so as to assure as great uniformity of sound output as possible. The whisper will be plainly audible to the examiner and use will be made of numerals, names of places, or other words or sentences, until the condition of the registrant's hearing is evident. The acuity of hearing will be expressed as a fraction, the numerator of which is the distance in feet at which the words are heard by the normal ear; thus 15/15 indicates normal hearing, 10/15 partial hearing of a degree indicated by the fraction, that is, the registrant hears at 10 feet distant the words which the normal ear hears at 15 feet."

The room in which the whisper tests were made was 20′6″ long, 4′7″ wide and 10′3″ high. The construction of this room facilitated the transmission of sound as would any closed tubular space.

Air crew applicants were also tested by the whisper. The hearing requirement for such personnel is 20/20. The hearing of trained flying personnel and applicants for commissions other than those for air crew training was tested, in accordance with regulations, by the low conversational voice, also at a distance of 20 feet. For the sake of uniformity in this paper, the numerator for all the men examined has been chosen as 15 feet. It was very exceptional to find a difference of hearing at 15 and 20 feet.

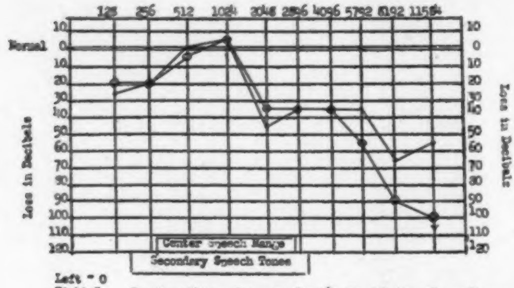
NERVE TYPE DEAFNESS.

Case	A. D.	Av. Db. Loss	A. S.	Av. Db. Loss	Findings
1	15/15	0	15/15	0	Drums normal
2	15/15	0	15/15	0	Drums normal. Dip at 2048
3	15/15	0	0/15	100+	Drums dull
4	15/15	0	0/15	55	Drums normal
5	15/15	0	0/15	40	Drums norm. Dip, low & high freq.
6	15/15	0	14/15	10	Drums normal
7	15/15	0	0/15	25	Drums dull, retracted
8	15/15	0	1/15	20	Drums normal
9	15/15	0	15/15	0	Drums normal. Dip at 1024
10	15/15	0	8/15	95	Drums normal
11	15/15	0	13/15	6	Drums normal. Dip at 2048
12	15/15	2	15/15	4	Drums normal
13	15/15	10	10/15	30	Drums normal
14	15/15	14	0/15	69	Drums normal
15	15/15	15	15/15	14	Drums normal. Dip at 2048
16	15/15	15	10/15	17	Drums normal. Dip at 2048
17	15/15	32	0/15	100+	Drums retracted
18	12/15	6	0/15	17	Drums thickened
19	12/15	10	0/15	17	Drums retracted
20	12/15	16	0/15	51	Drums normal
21	8/15	10	0/15	42	Drums retracted
22	8/15	15	15/15	0	Drums normal
23	8/15	31	3/15	25	Drums dull, thickened
24	8/15	34	8/15	5	Drums normal
25	8/15	46	0/15	72	Drums slightly retracted
26	8/15	61	0/15	17	Drums normal
27	7/15	49	0/15	100+	A.S.M.T. retracted and scarred, A D.M.T. normal
28	5/15	35	9/15	15	Drums norm. Dip, low & high freq.
29	5/15	54	5/15	28	Drums normal
30	3/15	11	2/15	13	Drums normal
31	3/15	30	0/15	27	Drums normal. Dip at 512
32	2/15	69	1/15	80	Drums thickened
33	1/15	12	4/15	20	Drums normal. Dip at 2048, from 5 to below 40, bilateral
34	1/15	19	0/15	14	Drums normal. Dip at 1024
35	1/15	95	8/15	50	Drums normal
36	0/15	21	15/15	0	Drums normal
37	0/15	26	0/15	32	Drums normal
38	0/15	27	0/15	30	Drums normal
39	0/15	29	0/15	29	Drums retracted
40	0/15	29	5/15	36	Drums normal
41	0/15	28	1/15	23	Drums normal. Dip at 2048
42	0/15	31	1/15	22	Drums normal
43	0/15	31	0/15	35	Drums normal
44	0/15	31	4/15	25	Drums normal
45	0/15	35	0/15	31	Drums retracted
46	0/15	54	3/15	41	Drums normal
47	0/15	55	15/15	6	Drums dull, retracted
48	0/15	100+	15/15	6	Drums normal
49	0/15	100+	13/15	46	Drums normal
50	0/15	100+	0/15	70	Drums normal
51	0/15	100+	5/15	91	Drums normal
52	0/15	100+	9/15	45	Drums normal
53	10/15	0	0/15	1	Drums normal

FIGURE 1.

A.D. - 15/15
A.S. - 15/15

MAICO AUDIOGRAM
Name________________________Date____________By________________

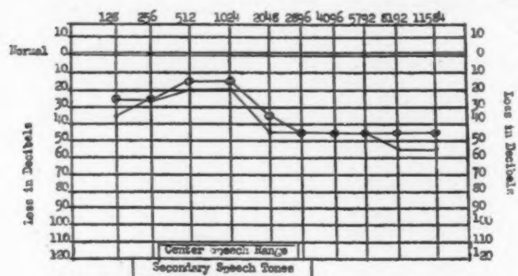


Left - O
Right = . Db. loss Whisp. Voice Air L. 14 R. 15 Bone L.___R.____

FIGURE 2.

A.D. - 0/15
A.S. - 1/15

MAICO AUDIOGRAM
Name________________________Date____________By________________

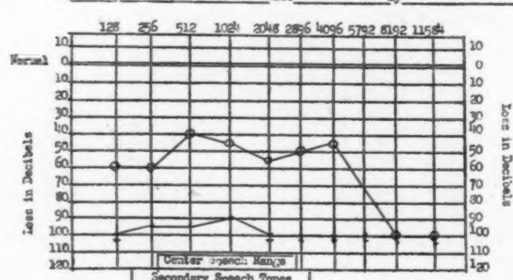


Left - O
Right = . Db. loss Whisp. Voice Air L. 23 R. 25 Bone L.___R.____

FIGURE 3.

A.D. - 1/15
A.S. - 8/15

MAICO AUDIOGRAM
Name________________________Date____________By________________



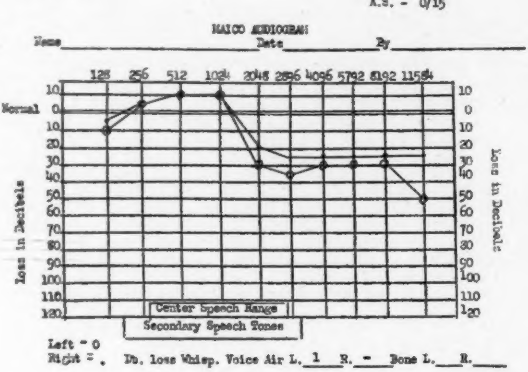
Left - O
Right = . Db. loss Whisp. Voice Air L. 50 R. 95 Bone L.___R.____

The cases have been divided into *1.* nerve type deafness, *2.* conduction type deafness, *3.* mixed type deafness, *4.* deafness associated with healed or active otitis media, *5.* deafness following injury or specific disease, *6.* deafness following mastoidectomy and *7.* otosclerosis. These diagnoses were made by the classical criteria which are so well known to otologists.

In this group the variations between hearing perception to whisper and average decibel loss were demonstrated by the following instances: In Case 15, hearing in both ears was 15/15 with average decibel loss 15 and 14 in A. D. and A. S. respectively; in Case 16, hearing in A. D. was 15/15 and in A. S. 10/15 with average decibel loss 15 and 17 in A. D. and A. S. respectively. The audiogram dipped at 2,048 dv. in each

FIGURE 4.

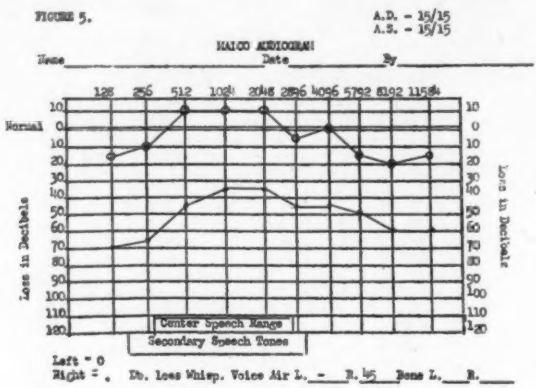
A.D. - 10/15
A.S. - 0/15



instance (see Fig. 1). Cases 18, 19, and 36 to 40 show many examples of 0/15 hearing perception with comparatively small average decibel losses (see Fig. 2). Cases 25 and 26 presented A. D. hearing perception of 8/15 with average decibel loss of 46 and 61 respectively. Case 30 showed A. D. hearing perception of 3/15 and A. S. hearing perception of 2/15 with only average decibel loss of 11 and 13 in A. D. and A. S. respectively. On the other hand, in Case 32, the hearing impairment was 2/15 in A. D. and 1/15 in A. S. with 69 and 80 average decibel loss respectively; in Case 35, the hearing

impairment was 1/15 in A. D. and 8/15 in A. S. with 95 and 50 average decibel loss respectively (see Fig. 3).

Case 53 presents the audiogram usually seen in nerve impairment incident to prolonged flying (see Fig. 4). This technical sergeant had 177 combat hours and 700 total flying hours. Tinnitus and impaired hearing in the left ear appeared recently. As is the rule, the audiogram curve dips at 2,048 dv.



Of interest is the fact that hearing perception in A. D. was 10/15 and in A. S. 0/15, yet there was only a difference of 10 db. at 2,048 dv.

CONDUCTION TYPE DEAFNESS.

Case	A. D.	Av. Db. Loss	A. S.	Av. Db. Loss	Findings
1	15/15	0	0/15	40	Drums dull. Predom. conduc.
2	15/15	0	0/15	57	Drums normal
3	15/15	5	3/15	26	A.S.M.T. retracted, A.D.M.T. normal Predom. conduc.
4	15/15	5	3/15	26	A.S.M.T. retracted, A.D.M.T. normal
5	15/15	25	0/15	100+	Drums normal. Predom. conduc.
6	15/15	45	15/15	0	Drums normal
7	12/15	18	1/15	31	Drums normal. Predom. conduc.
8	10/15	24	3/15	45	Drums normal
9	10/15	40	15/15	0	Drums normal
10	10/15	74	15/15	25	Drums normal. A. S. conduc., A. D. mixed
11	1/15	34	0/15	39	Drums normal. Predom. conduc.
12	0/15	30	0/15	26	Drums retracted
13	0/15	49	0/15	44	Drums normal

MIXED TYPE DEAFNESS.

Case	A. D.	Av. Db. Loss	A. S.	Av. Db. Loss	Findings
1	15/15	0	0/15	82	Drums normal
2	15/15	0	15/15	6	Drums normal
3	15/15	0	15/15	4	Drums normal
4	15/15	0	0/15	64	Drums normal
5	15/15	5	4/15	54	Drums normal
6	15/15	5	0/15	79	Drums normal
7	15/15	6	0/15	61	Drums normal
8	15/15	7	15/15	25	Drums normal
9	15/15	7	0/15	72	Drums normal
10	15/15	8	15/15	16	Drums retracted
11	15/15	9	15/15	2	Drums retracted
12	15/15	40	0/15	54	Drums normal
13	15/15	29	0/15	91	Drums normal
14	15/15	29	0/15	85	Drums retracted
15	14/15	4	5/15	10	Drums retracted
16	14/15	4	5/15	8	Drums normal
17	10/15	9	15/15	6	Drums normal
18	10/15	41	13/15	44	Drums normal
19	10/15	41	0/15	85	Drums normal
20	9/15	69	9/15	71	Drums normal
21	8/15	21	8/15	11	Drums normal
22	7/15	63	15/15	0	Drums normal
23	6/15	22	0/15	42	Drums normal
24	6/15	29	6/15	20	Drums normal
25	5/15	35	1/15	46	Drums normal
26	5/15	35	0/15	78	Drums normal
27	3/15	15	0/15	40	Drums normal
28	3/15	27	15/15	20	Drums normal
29	3/15	40	0/15	81	Drums normal
30	2/15	22	0/15	46	Drums slightly retracted
31	1/15	30	0/15	31	Drums normal
32	1/15	35	0/15	43	Drums normal
33	1/15	39	15/15	0	Drums normal
34	1/15	42	10/15	29	Drums normal
35	1/15	95	8/15	69	Drums normal
36	0/15	25	0/15	36	Drums dull, retracted
37	0/15	25	0/15	30	Drums retracted
38	0/15	29	0/15	21	Drums thickened
39	0/15	31	0/15	25	Drums normal
40	0/15	31	0/15	25	Drums normal
41	0/15	32	15/15	0	Drums retracted
42	0/15	32	0/15	53	Drums retracted
43	0/15	38	0/15	44	Drums normal
44	0/15	51	0/15	61	Drums dull, retracted
45	0/15	56	0/15	79	Drums normal
46	0/15	56	0/15	60	Drums normal
47	0/15	64	0/15	63	Drums normal
48	0/15	75	1/15	15	Drums normal
49	0/15	74	10/15	24	Drums normal
50	0/15	100+	15/15	29	Drums retracted
51	0/15	100+	10/15	39	Drums normal
52	0/15	100+	15/15	20	Drums normal

FIGURE 6.

A.D. - 1/15
A.S. - 0/15

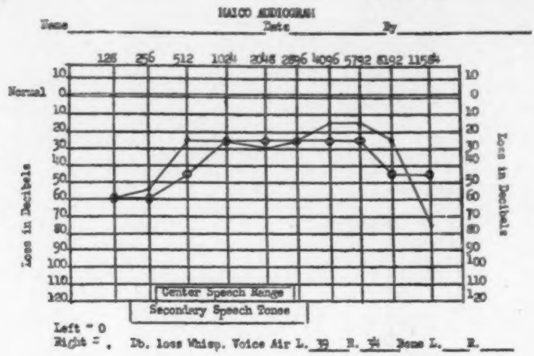


FIGURE 7.

A.D. - 0/15
A.S. - 0/15

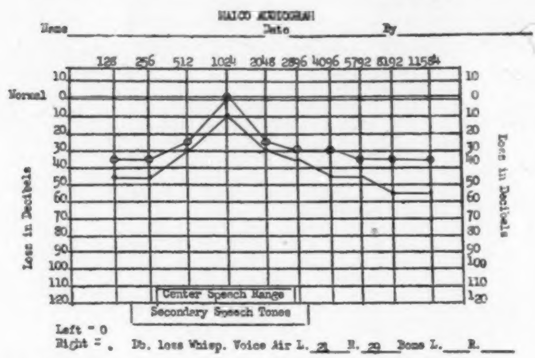
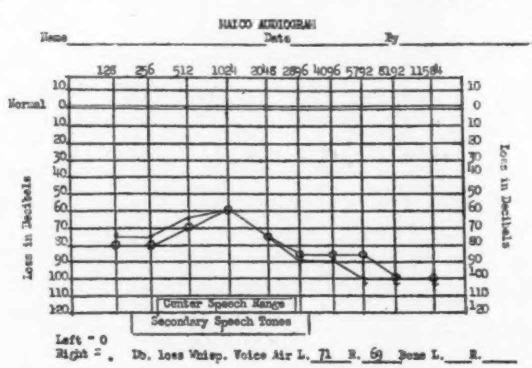


FIGURE 8.

A.D. - 9/15
A.S. - 9/15



There are several marked variations among these cases. Case 6 with 15/15 hearing perception in A. D. presents an average decibel loss of 45 (see Fig. 5), Case 10 with 10/15 hearing perception in A. D. presents average decibel loss of 74, while Case 11 with 1/15 hearing perception in A. D. presents average decibel loss of 34 (see Fig. 6).

These patients illustrate the thesis of this paper especially well. There are many instances of great differences between hearing perception and average decibel loss. Case 31 with hearing perception as low as 1/15 in A. D. and 0/15 in A. S., and Case 38 (see Fig. 7), with hearing perception of 0/15 in each ear, present audiograms with comparatively small average decibel losses. In Case 20, on the other hand, the average decibel loss in A. D. is 69 and in A. S. 71 with the comparatively good hearing perception of 9/15 in each ear (see Fig. 8).

DEAFNESS ASSOCIATED WITH HEALED OR ACTIVE OTITIS MEDIA

Case	A. D.	Av. Db. Loss	A. S.	Av. Db. Loss	Findings
1	15/15	0	0/15	42	A.S.M.T. scarred. A.D.M.T. normal
2	15/15	10	7/15	20	A.D.M.T. retracted. A.S.—O.M.P.C.
3	15/15	25	0/15	100+	A.S.—O.M.P.C. A.D.M.T. normal
4	15/15	42	0/15	38	A.D. and A.S.—O.M.P.C.
5	11/15	20	0/15	65	A.D.M.T. normal. A.S.M.T. healed with web
6	9/15	6	10/15	7	A.D. and A.S.—O.M.P.C.
7	7/15	50	0/15	100+	A.D.M.T. scarred, healed. A.S.M.T. normal, nerve type
8	5/15	0	0/15	35	A.S.M.T. perforation dry. A.D.M.T. normal
9	3/15	46	4/15	12	A.D. and A.S.—O.M.P.C.
10	3/15	46	15/15	0	A.D.—O.M.P.C., exacerbation. A.S.M.T. normal
11	1/15	40	5/15	42	A.D.M.T. and A.S.M.T., perf., dry.
12	0/15	38	0/15	32	A.D.M.T. and A.S.M.T., healed, scarred, retracted
13	0/15	48	15/15	2	A.D.M.T. and A.S.M.T. healed by webs
14	0/15	70	15/15	29	A.D.—O.M.P.C. A.S.M.T. retracted
15	0/15	90	0/15	100+	A.D. and A.S.—O.M.P.C.

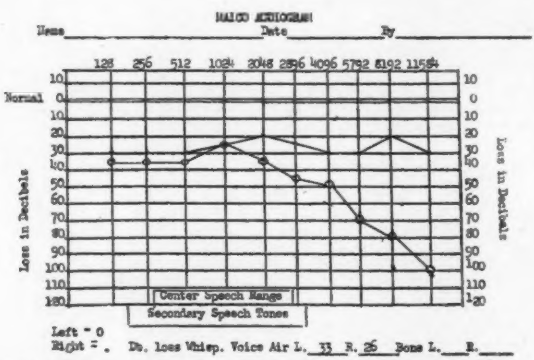
A review of these cases shows that average decibel loss is also not constant for ears with active discharges and that the usual variations exist.

DEAFNESS FOLLOWING INJURY OR SPECIFIC DISEASE.

Case	A. D.	Av. Db. Loss	A. S.	Av. Db. Loss	Findings
1	15/15	0	0/15	32	Deafness A.S. following measles. A.S.M.T. thickened. A.D.M.T. normal
2	9/15	26	0/15	61	Deafness bilateral following pressure chamber. Drums retracted
3	0/15	29	0/15	38	Deafness bilateral, probably due to overdose quinine. Drums normal. Nerve type
4	5/15	71	0/15	90	A.S. struck with baseball 13 years ago. Drums normal. Nerve type
5	4/15	23	1/15	28	Deafness and tinnitus following influenza and pneumonia, 1918. Drums retracted. Predom. nerve type
6	1/15	35	1/15	37	Deafness following fall from tree 15 years ago. Drums normal. Nerve type
7	0/15	17	0/15	26	Deafness following diphtheria at age of 8. Drums normal. Nerve type
8	0/15	55	15/15	21	Deafness following meningitis. Drums normal. Nerve type

FIGURE 9.

A.D. - 15/15
A.S. - 9/15



These patients with 0/15 hearing perception show variation in average decibel loss from 17 to 90. These ears, however, present more consistently low audiograms than are found in the rest of this series.

DEAFNESS FOLLOWING MASTOIDECTOMY.

Case	A. D.	Av. Db. Loss	A. S.	Av. Db. Loss	Findings
1	15/15	26	9/15	33	Bilateral healed mastoidectomy
2	12/15	19	5/15	17	Drums scarred. Bilateral healed mastoidectomy
3	1/15	38	5/15	11	Drums normal. Bilateral healed mastoidectomy
4	0/15	100+	15/15	38	Drums normal. A.D. healed mastoidectomy

In Case 1, hearing perception in A. D. is 15/15 with 26 average decibel loss and in A. S. 9/15 with 33 average decibel loss (see Fig. 9). In Cases 2 and 3, hearing perception in the left ears is 5/15 with average decibel losses of 17 and 11 respectively.

OTOSCLEROSIS.

Case	A. D.	Av. Db. Loss	A. S.	Av. Db. Loss	Findings
1	15/15	0	1/15	25	Drums normal
2	14/15	10	14/15	8	Drums normal
3	13/15	13	9/15	12	Drums normal
4	3/15	25	2/15	34	Drums normal
5	3/15	27	0/15	35	Drums normal
6	2/15	35	2/15	26	Drums normal
7	2/15	49	0/15	62	Drums normal
8	1/15	12	1/15	17	Drums normal
9	1/15-L.* 8/15-H.	23	1/15	29	Drums normal
10	1/15	35	1/15	25	Drums normal
11	1/15	37	2/15	30	Drums normal
12	1/15	55	1/15	62	Drums normal
13	0/15	20	0/15	23	Drums normal
14	0/15	20	0/15	19	Drums normal
15	0/15	25	0/15	21	Drums normal
16	0/15	26	0/15	36	Drums normal
17	0/15	34	0/15	32	Drums normal
18	0/15	34	0/15	43	Drums normal
19	0/15-L. 15/15-H.	34	0/15	34	Drums normal
20	0/15	45	1/15	35	Drums normal
21	0/15	52	.0/15	62	Drums normal
22	0/15	69	0/15	52	Drums normal

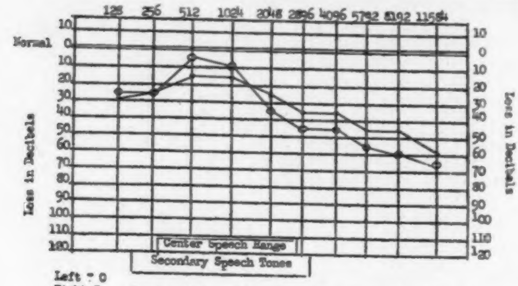
*L.—Low sounds like 44.
H.—High sounds like 66.

These cases were carefully selected and can be considered as typical. Among these patients, Cases 8 and 12 are illustrative of marked variations. In Case 8, hearing perception was 1/15 in both ears with average decibel loss of 12 in A. D. and 17 in A. S., while in Case 12, whose hearing perception was also 1/15 in both ears, the average decibel loss was 55 in A. D. and 62 in A. S. Hearing perception of 0/15 in each ear in Case 14 cannot be interpreted by the audiogram which shows 20 average decibel loss in A. D. and 19 average decibel loss in A. S. (see Fig. 10). Case 19 is of interest in that both ears present average decibel loss of 34 but hearing perception in A. D. is 0/15 to the low whisper and 15/15 to the

FIGURE 10.

A.D. - 0/15
A.S. - 0/15

HAICO AUDIOGRAM
Name________________________ Date__________ By______________

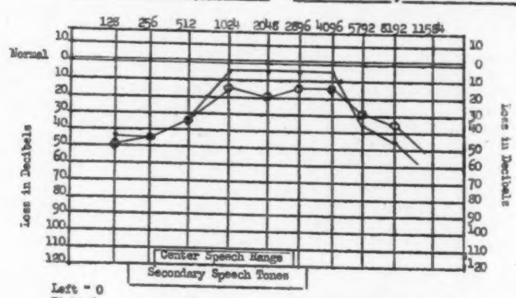


Left = 0
Right = . Db. loss Whisp. Voice Air L. 19 R. 20 Bone L.__ R.____

FIGURE 11.

Low High
A.D.- 1/15 8/15
A.S.- 1/15

HAICO AUDIOGRAM
Name________________________ Date__________ By______________

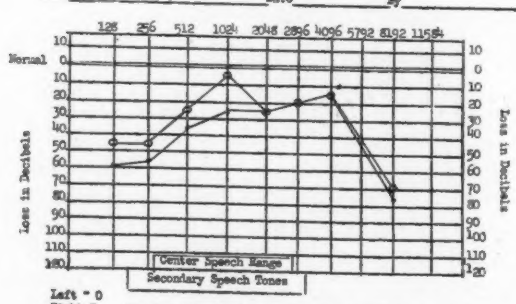


Left = 0
Right = . Db. loss Whisp. Voice Air L. 29 R. 23 Bone L.__ R.____

FIGURE 12.

A.D. - 1/15
A.S. - 1/15

HAICO AUDIOGRAM
Name________________________ Date__________ By______________



Left = 0
Right = . Db. loss Whisp. Voice Air L. 25 R. 35 Bone L.__ R.____

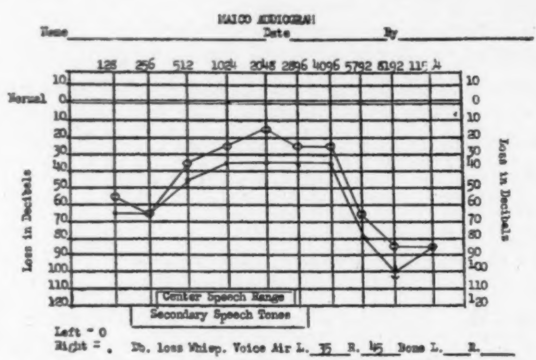
high whisper while in A. S. it is 0/15 to all grades of whisper. Audiograms of Case 9 (see Fig. 11), Case 10 (see Fig. 12) and Case 20 (see Fig. 13) are included for study.

COMMENT.

A study of the above data reveals that there is no constant correlation between hearing perception as determined by the whisper or low conversational voice tests and the air-conduction audiograms. The variations between the two findings

FIGURE 13.

A.D. - 0/15
A.S. - 1/15



have a wide range; however, there does seem to be a close relationship between whisper hearing perception and audiometric findings when impaired hearing exists in both ears in the same individual. Similar audiogram readings (average decibel loss) have been obtained for both ears in instances of bilateral deafness with approximately equal hearing impairment to the whisper in both ears.

In testing the hearing acuity of military personnel, I have come to rely almost completely on the whisper and low conversational voice tests to determine fitness for duty. In my experience so far, these tests, in combination with tuning fork tests, have evaluated the clinical picture more accurately and have had more practical significance than audiometric studies alone. One of the main practical functions of the acoustic organ is to hear and understand the human voice and it appears that the human voice still offers the best means for determining acuity of hearing for speech.

It should not be assumed from this study that the whisper and low conversational voice tests present the most accurate means of interpreting man's hearing perception. Not infrequently the low conversational voice test appeared to be superior to the whisper test in evaluating hearing perception. Unfortunately, the variations in low conversational voices preclude their use as a standard in hearing tests. The presentation of the spoken voice by phonograph records, as suggested by Macfarlan[1] and recently by Hughson and Thompson,[2] or through a microphone over a controlled amplifying system, as also suggested by Hughson and Thompson,[2] may be a more satisfactory solution to this problem. It was my clinical impression, however, that the whisper test offered the most efficient and practical method available to determine auditory acuity and that the results obtained corresponded to the obvious deafness to a satisfactory degree.

Audiometric findings, on the other hand, serve other purposes in the studies of deafness. The audiogram offers great aid in the diagnosis of the different types of hearing impairment, a permanent record of the hearing and a method to record variations in hearing over a period of years. In flying personnel, the audiogram is also of value in detecting and demonstrating evidences of nerve deafness, particularly in the early stages, which supposedly results from long association with the noises incident to airplanes. The dip in the curve usually occurs at 2,048 or 2,896 dv. It is very likely that too many additional complex factors enter the formation of vocalized speech for it to be compared with the composite individual frequencies believed to be included in the speech range of the audiometer.

Further valuable information on this subject can be supplied by the men who are performing the vestibular fenestration operations. It is suggested that records of improved hearing as detected by audiograms be accompanied by records of whisper and conversational voice tests.

BIBLIOGRAPHY.

1. MACFARLAN, D.: Speech Hearing and Speech Interpretation Testing. *Arch. Otolaryngol.*, 31:517, March, 1940.

2. HUGHSON, W., and THOMPSON, E.: Hearing Aids. *Arch. Otolaryngol.*, 39:245, March, 1944.

A REVIEW OF THE AVAILABLE LITERATURE ON THE PHARYNX AND PHARYNGEAL SURGERY FOR 1943.*

FRANCIS E. LEJEUNE, M.D.,

New Orleans.

BACTERIOLOGY.

Smillie, Calderone and Onslow[1] made a study of the prevalence of various types of pneumococci in the nasopharynges of a group of occupants of one of the New York City Municipal Lodging Houses from December, 1940, to June, 1941. The purpose of the investigation was to determine the spread from person to person of the various types of pneumococci under conditions most favorable for their transmission. The period under study was relatively free of serious respiratory infections. Of 111 men examined, 643 stains were isolated from the nasopharyngeal cultures. There was no seasonal variation of carrier incidence chiefly because it was extremely high at all times. During the late spring months the number of pneumococci in the throats of the carriers seemed to increase. Only types I and XXXIII of the standard types of pneumococcus were not encountered at least once. This study emphasized that types I and II have definite epidemiologic significance and whenever they are found in more than 3 per cent of any population, it is an index of potential danger.

Miller and his associates[2] report an amplification of their findings from an earlier study of the comparative reliability of the nasopharyngeal swab and the cough plate in the diagnosis of whooping cough and hemophilus pertussis carriers. A total of 342 comparative tests with nasopharyngeal swabs and cough plates were made in 214 cases of whooping cough. It was noted that the culture test became less reliable as the disease progressed. In the entire series it was found that 63 per cent were positive by swab at some time in their course and 49 per cent were positive by cough plate. The

*From the Department of Otolaryngology, Tulane University of Louisiana School of Medicine, and the Section on Ear, Nose and Throat, Ochsner Clinic, New Orleans.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, Oct. 1, 1944.

results indicated that the use of both procedures was superior to that of the swab alone. These authors believe that nasopharyngeal swab cultures are more practicable and more productive and should be used in public health laboratories.

BLOOD SUPPLY.

Grove[3] reports the case of an 11-year-old boy who had an abscess of the parapharyngeal space, which was evacuated through an incision along the anterior border of the sternocleidomastoid muscle. On the sixth postoperative day there was bleeding controlled by a large gauze pack. On the eighth postoperative day the child had a large spontaneous hemorrhage from the ascending pharyngeal artery, which was ligated with considerable difficulty. Convalescence was complicated by the necessity for a simple mastoid operation. Grove calls attention to the necessity of draining pharyngomaxillary abscesses through the external route rather than through an intraoral incision, since death from uncontrollable hemorrhage has frequently followed the intraoral route. In the case reported, the hemorrhage was sufficiently controlled by packing until the offending vessel could be ligated. Grove calls attention to the fact that the case is of particular interest because it illustrates that erosion of vessels by the necrotizing, gangrenous effects engendered by the infection can occur days after the abscess has been drained.

CANCER.

Martin[4] has presented a general discussion on cancer of the nasopharynx, including pathology, local growth, intracranial extension, lymph node involvement, generalized metastases and treatment. He states that the lesion originates most frequently in the pharyngeal tonsil and fossae of Rosenmüller and less frequently in the periphery of the choanae and the posterior nasopharyngeal wall. The growth produces nasal obstruction, epistaxis, nasal discharge, chronic sore throat, postnasal pain, dysphagia and a sensation of a lump in the throat. Local extension causes deafness, tinnitus and sometimes otitis media. Intracranial extension is found in about one-third of the cases. Enlarged cervical lymph nodes occur sooner or later in almost all cases. Metastasis appears

fairly rapidly and may be demonstrated in the chest, bones, liver, kidneys, spleen and retroperitoneal lymph nodes. It is generally agreed that surgery offers little. Martin points out that 85 per cent of primary lesions in this region are so "radio-sensitive that they can be completely eradicated by doses of irradiation which produce no irreparable damage to the normal tissues." From a review of his cases he found that many of the failures resulted from the appearance of metastases in the mediastinum or in the intracranial cavity four to six months after disappearance of all evidence of the disease in the pharynx and cervical region; therefore, he believes that more cures might be obtained by administering additional irradiation to the base of the skull and thorax in the early stages of the disease. Some improvements in the technique of administration of irradiation are given.

Persky[5] reports the case of a lymphoepithelioma of the tonsil and nasopharynx. The unusual features of this case were: The occurrence of the growth in the tonsil; the belated appearance of cervical adenopathy (probably metastatic); the appearance of the tumor in the nasopharynx and the prompt regression of the growth following institution of high voltage Roentgen therapy.

The clinical picture of the lymphoepithelioma is that of a slow-growing, infiltrating tumor with a tendency to early metastases producing symptoms of nasal obstruction, difficulty in breathing and obstruction of the Eustachian tube. In all cases of slow, progressive nasal obstruction, deafness and spontaneous unaccountable hemorrhage from the nose or throat, Persky believes that posterior rhinoscopy, nasopharyngoscopy and digital examination of the nasopharynx should be routine. In the early stages and even in cases in which metastasis is limited to a few cervical nodes, irradiation has given good results.

In an article in which Burman and Burman[6] review the literature on Schmincke tumor, they define this lesion as "a malignant neoplasm of lymphoid tissue, usually in the pharyngeal region, characterized by a peculiar admixture of lymphoid cells, intimately associated with epithelial elements of an immature squamous or epidermoid type, which tends to

metastasize early and rapidly and is highly malignant and extremely radio-sensitive." They discuss the history, clinical manifestations, diagnosis, etiology, pathology, treatment and prognosis and report three cases of Schmincke tumor, encountered within a period of six months, all proved microscopically. The first case was a 62-year-old Italian treated by radiation, who was eventually transferred to the psychopathic ward and died about a month later. The second case was an 86-year-old Italian man, treated by radiation; when last seen two months after Roentgen therapy was begun, the primary tumor was destroyed. Two months after this, the patient died of "carcinoma of the tonsil, with extension to the tongue; purulent bronchopneumonia and sepsis after operation for a Witzel fistula." The third patient was a 62-year-old woman who received radiation therapy for a period of two weeks but failed to return after termination of treatment.

Belanger and Dyke[7] made a study of 14 cases of malignant tumor of the nasopharynx seen within the past decade at the Neurological Institute and Presbyterian Hospital in New York, all of which were verified histopathologically and in which stereoscopic Roentgenograms of the skull in the basal position, in addition to the routine plates, were made. A comparison of the findings in the Roentgenograms taken in both the lateral and basal positions showed that although the lateral view can offer information only regarding the nature of the pathologic process, the basal view is usually necessary to establish definitely the diagnosis of nasopharyngeal malignancy. They describe in detail the specific soft tissue and osseous changes produced by malignant nasopharyngeal tumors which they found demonstrated in the Roentgenograms. They call attention to the fact that, although it may be argued that the value of Roentgenologic diagnosis is diminished since it is based on changes occurring late, it is just as difficult for the clinician to make an early diagnosis because of the paucity or unlocalizable character of the symptoms.

DeBoissiere[8] briefly reviews the types, pathology and symptomatology of nasopharyngeal neoplasms and reports the case of a 54-year-old woman with a carcinoma situated

between the septum and middle turbinate which had penetrated into the skull and involved not only the body of the sphenoid but also the clinoids and left optic tract. Moure's lateral rhinotomy was performed and postoperative radiation given. Roentgenograms made one year postoperatively revealed no evidence of recurrence or additional destruction of bone.

DISEASES.

Coates[9] and Leath[10] in similar articles call attention to the importance of performing a thorough and careful examination of the pharynx. Because it is the most difficult of all examinations to teach the student to make and interpret, it is often neglected or hastily done. The method of inspection, mirror examination, finger palpation, and use of the nasoscope, nasopharyngoscope, antrascope and posterior rhinoscope are described. The authors then describe the various pathologic conditions to be looked for during examination of the nasopharynx.

Freeman[11] made a study of 34 cases of acute pharyngeal infection treated by local application of sulfathiazole powder. The powder was applied to the pharyngeal mucosa with a compressed air powder syringe through the nose or with a shortened Eustachian tube catheter placed behind the soft palate. Subjective improvement was noted in one to 24 hours after the first treatment and the average time was 10 hours. Objective improvement was noted in from 24 to 56 hours and the average was 24.6 hours. An average of 2.2 treatments was required. The average duration of the disease after treatment was instituted was 2.4 days. Only 27.7 per cent of the patients showed any presence of free sulfathiazole in the blood. The advantages of this method of treatment, according to Freeman, are that it is inexpensive and easily carried out on ambulatory patients. Freeman states that this method of treating acute infections of the pharynx and nasopharynx has never been described before.

Murphy[12] presents a preliminary report of a pharyngeal syndrome which appears to be of virus origin. During the past 18 years he saw 17 cases; during an epidemic of keratoconjunctivitis 20 additional cases were seen in six weeks. The

patients complained of a sharp, shooting, distinctly neuralgic pain in the ear which never lasted more than a minute and was aggravated by coughing. Over the parietal region was an area of paresthesia about the size of the palm of a hand. The pharyngeal lesions, which were always unilateral, varied from a single ulcer on the buccal membranes to a massive area of herpetic lesions covering the entire soft palate, both pillars and the posterior pharyngeal wall. The condition appeared to be highly contagious, four cases having been seen in one family. Treatment consisted of administration of acetophenetidin and acid acetyl salicylic with codein phosphate for pain, mild alkaline irrigations plus application of dye antiseptics to the lesions and large doses of vitamin B.

Silber[13] reports his results in 32 patients with tonsillitis, pharyngitis and gingivostomatitis (Vincent's) treated with an absorbable salt of heptadiencarboxylic acid in coca butter suppositories. Symptoms disappeared within 24 to 48 hours after treatment was begun. No more than two suppositories at 24-hour intervals were required in all but one patient. There were no local ill effects or toxic reactions to the use of bismuth suppositories. The advantages of this method are ease of administration, freedom from danger of toxic reactions, avoidance of production of sulfonamide resistance or sensitivity by their use in conditions which may be relieved by more available medicaments, and avoidance of forced medication through an already inflamed area. Sibler reports 12 of the 32 cases in detail.

The treatment of chronic pharyngitis, a painful and disabling affliction, has been unsatisfactory, as evidenced by various treatments which have been suggested. It is generally agreed that following adenoidectomy and tonsillectomy, there is a tendency of the lateral pharyngeal tonsillar bands and other components of Waldeyer's ring to hypertrophy. Fricke and Pastore[14] treated 24 patients with this disorder by small doses of radium applied to the infected bands with a simple and practical applicator which they devised. Good results were obtained in all cases and no deleterious effects were noted. Although lymphoid tissue has been proved to be highly susceptible to irradiation, this appears to be transient; therefore, these authors believe that in all probability treat-

ment of these lateral bands should be repeated from time to time.

Viles[15] states that air-hammer operators claimed that whenever alcohol was used to blow out the water and ice in the compressed-air lines, they experienced considerable irritation in their noses and throats, lasting three or four hours and resulting in coughing and sore throat. A thorough investigation revealed that the sole responsibility for the irritation encountered rested with the sucrose octa acetate. To elimiinate exposure to this substance, it was recommended that accessible stand pipes be installed; these in turn would alleviate the possibility of forming alcohol mist on droplet nuclei of sucrose octa acetate in the air.

Warren[16] describes the various pathologic lesions occurring in the pharyngeal region. He particularly stresses the gross and microscopic appearance in an effort to aid in the differential diagnosis. The diseases considered include diphtheria, catarrhal pharyngitis, acute tonsillitis, acute catarrhal fever, phlegmonous pharyngitis, agranulocytic angina and Vincent's angina.

DIVERTICULA.

Edwards[17] describes a case of pulsion diverticulum of the esophagus in a 66-year-old man treated by a one-stage operation and Kerr-Parker aseptic disposition of the diverticulum followed by recovery without complications. According to the author, this is a procedure "which possesses all of the merits of the two-stage operation, lessening the possibility of infection and eliminating a second operation with its attendant longer hospital stay."

PATHOLOGY.

Emerson and Dowdy[18] noted improvement in cases of chronic otorrhea in the course of application of radium to the Eustachian orifice of children with Eustachian adenoids and hearing curves showing a predominant high tone loss. This led them to revaluate a large group of cases of chronic otitis media in respect to the possible etiology of their otorrhea. Thirty-five carefully selected patients with chronic

otorrhea due to hypertrophied lymphoid tissue in and about the Eustachian orifice received one application of 5 mg. hr. of radium; only rarely was a second treatment necessary. Excellent results were obtained in most cases; the degree of otorrhea was reduced in two cases and one was a complete failure. The applicator and technique used by the authors are described in detail. They state that this method is "by no means a cure for chronic otitis media; but in most cases where cessation of otorrhea is obtained, the patients are relieved of a most annoying symptom, and the hearing may be improved as well."

Most techniques for the application of irradiation to the nasopharynx in the treatment of certain types of impairment of hearing which have been described can be used only in hospitals and clinics. Jones[19] does not believe that anyone has described a technique which may be used in the office. In September, 1940, he requested that the Radium Emanation Corporation of New York City construct an applicator similar to the one used in the Department of Otology at Johns Hopkins. This applicator containing 100 millicuries of radon can be shipped by express. Because the radioactive power of radon decays with time, this company's service permits the exact use of the applicator.

Fisher[20,21] reports his results in the treatment of infected and hypertrophied lymphoid tissue in the nasopharynx by the application of radium. In a series of 100 cases,[20] 94 patients reported cessation of the postnasal discharge. Twelve patients with bilateral conduction deafness noted definite improvement in their ability to hear as proved by audiometric studies performed before and after radium treatment. Four patients with a definite history of allergic rhinitis were unimproved. In a later report[21] Fisher's series increased to 250 cases. The postnasal discharge ceased in 234. Examination with the electric nasopharyngoscope revealed diminution in the size of the lymphoid tissue in all these cases. Only 16 patients were unimproved; 11 of these had seasonal allergic rhinitis; six were definitely improved following a second treatment, whereas the other five were unimproved. The applicator and technique of application are described.

Fisher[22] reports definite improvement in ability to hear following treatment with radium in 45 carefully selected cases of conduction deafness. This was verified by audiometric studies made before and after treatment. Eleven patients required a second treatment and three, a third. The instrument used and the method of application are described.

ROENTGENOLOGY.

Westing[23] states that, although a complete examination of the nasopharynx, oropharynx, laryngopharynx and hypopharynx can be made by the rhinolaryngologist without the help of Roentgenograms, there are times when these can be of material assistance. In cases of malignancy, Roentgenograms will show extension to adjacent bones when present. The valleculae can be visualized in Roentgenograms of the oropharynx. Pharyngeal Roentgenograms add much confirmatory and contributory information. Westing describes a Roentgenoscopic technique for visualizing the lower half of the pharynx and the cervical esophagus which obviates the difficulties ordinarily arising during the opaque meal study of the alimentary tract. He emphasizes the necessity of returning to the pharynx and cervical esophagus after studying the stomach in order to make an adequate examination of these structures.

SURGERY.

Durbeck[24] points out the amenability of the lateral pharyngeal space to direct extension of inflammation from the posterior area of the mandibular body, to accidental invasion by a displaced impacted lower third molar and to retention of needle fragments broken during injection of the mandibular nerve. The foreign body may be identified Roentgenographically by exposure according to the standard lateral jaw technique. Durbeck states that exploratory entry must not be made at the same site as incision for drainage because of the necessarily small opening and the mechanically inadequate location of the latter. He suggests as a safe, practical approach an intraoral incision from the top of the coronoid process down the anterior border of the ramus; this prevents

severance of important nerves and vessels. The technique for removal of a foreign body is described.

TUMORS.

Smith and Ball[25] present a case of anomalous bony pharyngeal tumor in a 16-year-old girl. She complained of pain in the right side of the neck and some slight difficulty in swallowing. The growth was an elongated smooth swelling situated in the pharynx with its long axis located vertically in the posterior pharyngeal wall and extending from the level of the soft palate above to the level of the aditus laryngis below. The lower half was hard and well-defined, but the upper part was soft. The authors postulate that the tumor was a remnant of the hypochordal bar.

Wirth and Shimkin[26] report the case of a 16-year-old boy with a chondrosarcoma of the nasopharynx which was originally diagnosed as juvenile angiofibroma. Roentgen-ray treatment and application of radon were given without effect; the major portion of the mass in the left side of the nasopharynx, antrum, pharyngeal wall and pterygoid fossa was removed. There was some residual growth in the region of the sphenoid sinus and nose, just above the middle turbinate, which was removed by gross dissection. About a month after the operation it was noted that the left inferior turbinate was surrounded by a small globular mass of tumor. In an attempt to excise this mass, small bits of tissue were removed from the medial and posterosuperior walls of the antrum and consisted of residual tumor as well as of small chips of bone and cartilage. About six months after the operation a second operation was performed. After preliminary tracheotomy the anterior wall of the left antrum, the entire infraorbital ridge, the left eye and the intraorbital contents were removed. The tumor had refilled the antrum and extended from the orbital medial wall backward to the sphenoid bone. Radon was again implanted in the residual mass. The patient became progressively worse and died about 3½ years after the onset of his illness. The pathologist made the diagnosis of chondrosarcoma of the nasopharynx with penetration into the cranial cavity and metastases to the lungs.

LaRochelle[27] presents a detailed discussion of nasopharyngeal tumors including etiology, clinical study, auricular signs, respiratory signs, painful signs, clinical examination, invasion of the tumor, diagnosis and treatment. He reports the case of a 72-year-old woman with a tumor on the inferior border of the palate on the right. Deep radiotherapy decreased the size of the growth at least one-half. Biopsy revealed the growth to be an atypical epithelioma. The patient died about four months after she was first seen. Autopsy revealed a sarcoma invading the region of the pharynx and extending along the esophagus where it encircled the whole cervical portion. There was metastasis to the cervical ganglion and mediastinum.

In order to determine the end-results of treatment of malignant tumors of the nasopharynx, New and Stevenson[28] reviewed the history and microscopic pathology and follow-up of 271 patients treated prior to 1937. In this series 67.8 per cent were squamous cell carcinoma, 2.6 per cent adenocarcinoma and 15.9 per cent sarcoma; there was no positive evidence at biopsy in 13.7 per cent. The average age was 43.3 years; 76 per cent were men and 24 per cent women. All patients were treated by irradiation. Of the entire series with malignant lesions 13 per cent were living after five years. Of the patients with squamous cell carcinoma who did not have palpable lymph nodes 15.6 per cent were alive five years after treatment, whereas only 7.4 per cent of those with palpable lymph nodes survived five years.

Shemeley[29] briefly describes the clinical picture produced by a nasopharyngeal fibroma and reports a case in a man. The growth, which was about 7.5 cm. long and 3 cm. at the base and seemed to spring entirely from the posterior portion of the roof of the left nostril, was successfully removed.

In a general article on malignancy of the nasopharynx Cook[30] discusses the incidence, etiology, extension, diagnosis, types, symptoms, pathology, treatment and prognosis. He points out that the diagnosis may be difficult to make. He advises beginning with indirect mirror view by posterior rhinoscopy and considers essential in the examination direct vision nasopharyngoscopy, digital examination and biopsy.

He states that Roentgenologic examination is diagnostically important and valuable. Irradiation is considered the treatment of choice and the prognosis is more futile than for carcinoma in most other locations.

WOUNDS AND INJURIES.

Quincy[31] was able to find in the literature two cases similar to the one he reports of an 11-year-old boy, who suffered a burn of the hypopharynx produced by dry ice. Examination revealed considerable edema of the base of the tongue, hypopharynx and arytenoid cartilages. The child was treated with absolute bed rest, one teaspoonful of albolene every four hours and frequent mouth washes with dilute Dobell's solution. Sulfadiazine was given for secondary infection. On discharge one week after admission the patient could swallow small amounts of fluids with comfort. Fluoroscopic and Roentgenologic examination three months after the accident showed no deviation from the normal.

BIBLIOGRAPHY.

1. Smillie, W. G.; Calderone, F. A., and Onslow, Jeane M.: The Epidemiology of the Pneumococcus. The Prevalence of Pneumococci in the Throats of a Group of Homeless Men. *Am. Jour. Hyg.*, 37:156-163, March, 1943.

2. Miller, J. J.; Leach, C. W.; Saito, T. M., and Humber, J. B.: Comparison of the Nasopharyngeal Swab and the Cough Plate in the Diagnosis of Whooping Cough and Hemophilus Pertussis Carriers. *Am. Jour. Pub. Health*, 33:839-843, July, 1943.

3. Grove, W. E.: Abscess of the Parapharyngeal Space: Massive Hemorrhage, Recovery. A Case Report. *Ann. Otol., Rhinol. and Laryngol.*, 51:1053-1054, Dec., 1942; also, *Trans. Am. Laryngol. Assn.*, 64:144-145, 1942.

4. Martin, C. L.: Cancer of the Nasopharynx. *Ann. Otol., Rhinol. and Laryngol.*, 52:146-160, March, 1943.

5. Persky, A. H.: Lymphoepithelioma of the Nasopharynx. *Arch. Otolaryngol.*, 37:813-818, June, 1943.

6. Burman, H. J., and Burman, D.: Schmincke Tumor. Lymphoepithelioma of the Nasopharynx. *Arch. Otolaryngol.*, 37:835-844, June, 1943.

7. Belanger, W. G., and Dyke, C. G.: Roentgen Diagnosis of Malignant Nasopharyngeal Tumors. *Am. Jour. Roentgenol.*, 50:9-18, July, 1943.

8. deBoissiere, Vernon: A Case of Carcinoma of the Nasopharynx. *Canad. Med. Assn. Jour.*, 49:176-177, Sept., 1943.

9. Coates, George M.: The Nasopharynx. *Arch. Pediat.*, 60:10-18, Jan., 1943.

10. Leath, M. B.: The Significance of the Nasopharynx. *N. Car. Med. Jour.*, 4:53-55, Feb., 1943.

11. FREEMAN, M. S.: Local Use of Sulfathiazole Powder for Acute Pharyngeal Infections. *Arch. Otolaryngol.*, 37:496-501, April, 1943.

12. MURPHY, A. B.: A Pharyngeal Syndrome Probably of Virus Origin. *Ann. Otol., Rhinol. and Laryngol.*, 52:391-393, June, 1943.

13. SILBERS, S.: The Treatment of Tonsillitis, Pharyngitis and Gingivostomatitis with the Bismuth Salt of Heptadiene-carboxylic Acid in Cocoa Butter Suppositories. *Jour. Pediat.*, 23:59-68, July, 1943.

14. FRICKE, R. E., and PASTORE, P. N.: Radium Treatment of Granular or Hypertrophied Lateral Pharyngeal Tonsillar Bands. *Radiol.*, 41-256-260, Sept., 1943.

15. VILES, F. J.: Nasal and Pharyngeal Irritation from Contact with Sucrose Octa Acetate Among Operators of Compressed-Air Hammers. *U. S. Nav. Med. Bull.*, 41:1378-1379, Sept., 1943.

16. WARREN, S.: The Pathological Aspects of Acute Pharyngeal Infections. *U. S. Nav. Med. Bull.*, 41:1252-1257, Sept., 1943.

17. EDWARDS, R. H.: Pharyngoesophageal Diverticulum Treatment by One-Stage Disposition of the Sac. *W. Va. Med. Jour.*, 39:241-253, July, 1943.

18. EMERSON, E. B., and DOWDY, A. H.: Radium Therapy as an Aid in Control of Chronic Otorrhea. *Am. Jour. Roentgenol.*, 49:234-239, Feb., 1943.

19. JONES, E. H.: Irradiation of the Nasopharynx in Office Practice. *Arch. Otol.*, 37:436-438, March, 1943.

20. FISHER, G. E.: Recognition and Radium Treatment of Infected and Hypertrophied Lymphoid Tissue in the Nasopharynx. Peliminary Report. *Arch. Otolaryngol.*, 37:434-436, March, 1943.

21. FISHER, G. E.: Recognition and Radium Treatment of Nasopharyngeal Lymphoid Tissue. *South. Med. Jour.*, 36:702-703, Oct., 1943.

22. FISHER, G. E.: The Use of Radium in Conduction Deafness. *Ann. Otol., Rhinol. and Laryngol.*, 52:473-476, June, 1943.

23. WESTING, S. W.: Roentgenologic Examination of the Pharynx. *Am. Jour. Roentgenol.*, 49:587-592, May, 1943.

24. DURBECK, W. E.: Surgical Consideration of the Lateral Pharyngeal Space. *Jour. Am. Dent. Assn.*, 30:1083-1088, July, 1943.

25. SMITH, R., and BALL, J.: An Anomalous Bony Pharyngeal Tumor. *Jour. Laryngol. and Otol.*, 57:535-536, Dec., 1942.

26. WIRTH, J. E., and SHIMKIN, M. B.: Chondrosarcoma of the Nasopharynx Simulating Juvenile Angiofibroma. *Arch. Path.*, 36:83-88, July, 1943.

27. LAROCHELLE, PAUL: Un Cas de tumeur du Nasopharynx. *Union med. du Canada*, 72:1071-1076, Sept., 1943.

28. NEW, G. B., and STEVENSON, W.: End-Results of Treatment of Malignant Lesions of the Nasopharynx. *Arch. Otolaryngol.*, 38:205-209, Sept., 1943.

29. SHEMELEY, W. G., JR.: Nasopharyngeal Fibroma—Report of a Case. *Eye, Ear, Nose and Throat Mon.*, 22:380-381, Oct., 1943.

30. COOK, T. E.: Malignancy of the Nasopharynx. *Dallas Med. Jour.*, 29:114-119, Oct., 1943.

31. QUINCY, J. E.: "Dry Ice" Burn of the Hypopharynx. Report of a Case. *N. Eng. Jour. Med.*, 229:510, Sept. 23, 1943.

JAMES A. BABBITT, M.D.

IN MEMORIAM

JAMES A. BABBITT, M.D., 1869-1944.

Otolaryngology lost one of its best beloved practitioners on Oct. 15 in the death of Dr. James A. Babbitt at Lankenau Hospital, Philadelphia, where he had served as consulting otolaryngologist for many years. Dr. Babbitt had been ill over a year.

Born in Waitsville, Vt., in 1869, he graduated from Phillips Andover Academy in 1889, Yale University in 1893, Haverford College, 1896, and received his M. D. degree from the University of Pennsylvania School of Medicine in 1898.

In 1943, his colleagues honored him with the presidency of the American Laryngological Association; he was president of the American Academy of Ophthalmology and Otolaryngology in 1941; and of the American Laryngological, Rhinological and Otological Society in 1942. He was a Fellow of the American Otological Society and the Philadelphia Laryngological Association, and a member of the board of governors of the American College of Surgeons. Athletics were one of his chief interests and from 1906 to 1925 he was chairman of the Football Central Board of Officials and a member of the Rules Committee.

At Children's, Mary Drexel, Misericordia, University and Fitzgerald-Mercy Hospitals he served as consulting laryngologist and also served on the courtesy staffs of Bryn-Mawr, Chestnut Hill, Episcopal and Presbyterian Hospitals. He was emeritus professor at Haverford College and the University of Pennsylvania.

In World War I he was chief surgeon at a hospital in France.

His contributions to otolaryngological literature were legion, yet each one reflects the scientific experience and critical judgment of the author and lends dignity and honor to

the profession. He was an active member of the editorial staff of THE LARYNGOSCOPE and we shall miss his friendly help and wise counsel. His membership in the various national otolaryngological societies was a source of ardent interest to him and he keenly enjoyed their meetings and participation in their programs. We shall miss his friendly countenance and quiet but cordial greetings at future meetings.

Endowed with an understanding heart, a keen sense of humor, a deep enthusiasm, he exemplified the noblest attributes of his profession. His every action was motivated by the highest ideals, and he did not spare himself in his service to humanity. He was never known to speak ill of another and he will be sadly missed not only by his contemporaries but also by the younger men in the profession to whom he was invariably kind and encouraging. For these attributes he was rewarded by the respect, affection and loyalty of his many co-workers, and his influence will be an everlasting inspiration to otolaryngologists.

To his family we offer our sincere sympathy in this irreparable loss.

T. E. W.

DIRECTORY OF MEDICAL SPECIALISTS.

The biographical data of the first two editions of the Directory of Medical Specialists include only positions (internships, residences or assistantships) held during the course of training of men up to the time of their certification by the American Boards, and hospital and medical school staff positions then currently held.

It is desired to extend this data in the third edition to include all formal hospital and medical school appointments, with dates held, even though now resigned, as well as records of all military service including commissions and dates, either in World War I, peacetime in the reserve forces or in the present war. Thus, a chronologically complete sketch of a diplomat's entire career is to be included in this third edition of the Directory.

Membership or fellowship in national or sectional (not local) special societies, and national general societies with offices held, and dates, in any of these, should be reported.

Membership in recognized international medical societies may be included, but honorary or other membership in foreign medical societies should not be reported.

Reference to the second edition (1942) of the directory may be made for lists of medical societies to be included in one's biographic sketch.

Families or secretaries of men absent in military service are asked to complete or correct previous listings or new forms now being mailed to those eligible for inclusion in the directory. Only those certified by an official American Board can be included, and there is no charge for this listing.

The foregoing notice is published in response to many inquiries, to assist those certified by the Board who are now engaged in correcting their previous listings, or preparing new sketches for the third edition of the directory to be published early in 1945.

Communications should be addressed to the Directory of Medical Specialists, 919 North Michigan Avenue, Chicago, Ill.

DIRECTORY OF NATIONAL OTOLARYNGOLOGIC SOCIETIES.

AMERICAN OTOLOGICAL SOCIETY.

President: Dr. Gordon Berry, 36 Pleasant Street, Worcester, Mass.
Secretary: Dr. Isidore Friesner, 101 E. 73rd Street, New York.

AMERICAN LARYNGOLOGICAL ASSOCIATION.

President: Dr. Charles J. Imperatori, 108 E. 38th Street, New York.
Secretary: Dr. Arthur W. Proetz, Beaumont Building St. Louis.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Albert C. Furstenberg, University Hospital, Ann Arbor, Mich.

Secretary: Dr. C. Stewart Nash, 708 Medical Arts Building, Rochester, N. Y.

SECTIONS:

Eastern—Chairman: Dr. Oram R. Kline, 414 Cooper Street, Camden, N. J.

Southern—Chairman: Dr. Verling K. Hart, 106 W. 7th Street, Charlotte, N. Car.

Middle—Chairman: Dr. Carl H. McCaskey, 608 Guarantee Bldg., Indianapolis, Ind.

Western—Chairman: Dr. Aubrey G. Rawlins, 384 Post Street, San Francisco, Calif.

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY.

Chairman: Dr. Louis H. Clerf, 1530 Locust Street, Philadelphia.

Secretary: Dr. Fletcher D. Woodward, 104 E. Market Street, Charlottesville, Va.

Place: New York, N. Y.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Lawrence T. Post, 508 N. Grand Boulevard, St. Louis.

President-Elect: Dr. Gordon B. New, Mayo Foundation, Rochester, Minn.

Executive Secretary: Dr. William L. Benedict, Mayo Clinic, Rochester, Minn.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION.

President: Dr. Carlos E. Pitkin, Carnegie Medical Building, Cleveland, Ohio.

Secretary: Dr. Paul Holinger, 700 N. Michigan Avenue, Chicago.

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. M. E. Trainor, 523 W. 6th, Los Angeles.

Vice-President: Dr. Kenneth Brandenburg, 707 Security Building, Long Beach, Cal.

Secretary-Treasurer: Dr. Orrie E. Ghrist, 210 N. Central, Glendale, Cal.

Committeewoman: Dr. Etta C. Jeancon, 523 W. 6th Street, San Francisco.

Place: Los Angeles County Medical Association Building, 1935 Wilshire Boulevard, Los Angeles.

Time: 6:00 P.M., fourth Monday of each month, September to May, incl.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY.

President Dr. Romeo A. Luongo, 2054 Locust Street, Philadelphia.

Secretary: Dr. Jacob Daley, 104 East 40th Street, New York.

CONTENTS